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THE THIRD EDITION, CORRECTED;

With the ADDITION of two useful Plates on the CONSTRUCTION of STAIR CASES.

By THOMAS SKAIFE, P. A.

LONDON:

Printed for R. BALDWIN, No. 47, Pater-noster-Row, 1788.

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Key to Civil Architecture;

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[illegible]

A New Collection of [illegible]

[illegible]

TO
THE READER.

THE following ſheets, now offered to the Publick, were the produce of my leiſure hours. How far I have ſucceeded in the different matters I have treated of, I leave to the candour and judgement of a critical and diſcerning world, deſiring no approbation, but what reſults from the merit of the work; and humbly hoping, that no one will be too anxious to cenſure any point, before he hath well weighed the conſequences of it.

If any perſon ſhould traduce me for diſcovering the ſecrets of the building branch, relative to the prices of work, I muſt inform him, that I conſidered theſe as the firſt rudiment of my plan, in

in order to give every journeyman (which I think he has a right to) a view of the principles and profits of his business.

I humbly dedicate my endeavours to all in the building branches; and am with respect their

Most humble, and

Most obedient Servant,

Thomas Skaife.

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A KEY TO CIVIL ARCHITECTURE.

INTRODUCTIONS TO MECHANICKS.

ALL the liberal arts, and various ſtudies, which the buſtling world are daily in purſuit of, may be generally compriſed under the following heads, *natural*, *divine*, and *artificial*.

To the firſt of theſe is reducible, not only the government of this great Univerſe, but the knowledge of the uſual cauſes of Providence in the frame of every created thing.

To the ſecond may be referred, the practice of all thoſe virtues, which can advantage our minds in the ſearch or enquiry after their promiſed happineſs.

To the laſt belong all thoſe inventions, whereby Nature is any way aſſiſted in her defects: theſe artificial experiments being (as it were) but ſo many eſſays, by which men naturally attempt to relieve themſelves

from the firſt general curſe inflicted upon their labours. Though different the operations, it is ſtill one cauſe; whether a man be emulous of honour, wealth, or fame: I muſt confeſs, none of theſe motives induced me to the following undertaking, yet my readers will hardly be perſuaded, that I had no other view in the attempt, than an earneſt deſire to propagate the fruits of my induſtry for the univerſal benefit of mankind. However, if I may be allowed to alledge my reaſons, I muſt affirm they are centred ſolely in the laſt obſervation; as, I hope, my endeavours and examples in the following work will plainly evince.

I am far from the opinion of the ancient philoſophers, who eſteemed it a great part of their wiſdom to conceal their learning from vulgar apprehenſion and uſe, thereby the better to maintain it in its due honour and reſpect: and therefore generally veiled all their arts and ſciences under ſuch myſtical expreſſions, as might excite the people's wonder and reverence; fearing leſt a more eaſy and familiar diſcovery might expoſe them to contempt. Hence it was, that the ancient mathematicians placed all their learning in abſtracted ſpeculation; refuſing to debaſe the principles of that noble ſcience into mechanical experiments: inſomuch, that thoſe very authors amongſt them, who were moſt eminent for their inventions of this kind, and were willing, by their own practice,

tice, to manifeſt unto the world thoſe artificial wonders, which might be wrought by theſe arts, as Archimedes, Dædalus, &c. were, notwithſtanding, ſo much infected with this blind ſuperſtition, as not to leave any thing in writing concerning the grounds and manner of ſuch operations; by which means poſterity unhappily loſt, not only the benefits of their peculiar diſcoveries, but, for many centuries, the proficiency of the arts in general: for when once learned men forbid the reducing them to particular uſe, and vulgar experiments, others refuſed thoſe ſtudies, as uſeleſs and empty ſpeculations: whence it came to paſs that the ſcience of geometry was ſo univerſally neglected, as to receive but little or no addition for many hundred years together. The divine Plato is reported to have been a ſtickler for this fooliſh opinion; adviſing all his followers from proſtituting mathematical principles unto common apprehenſion or practice; and, in this ſuperſtition to philoſophy, rather choſe to deprive the world of all his uſeful and excellent inventions, than to expoſe that profeſſion to the ignorant vulgar: but his pupil Ariſtotle (as in many other particulars, ſo likewiſe in this) very juſtly oppoſed him; and became one of the firſt authors who have written any practical diſcourſe on theſe arts. Since him, many other authors of eminence have left maſterly works, chooſing rather a general benefit, than the hazard that might

accrue from the vain and groundless disrespect of these formal bigots; rightly preferring the reality and substance of publick good, before the shadows of some retired speculation, and ingrate vulgar opinion.

LECTURE I.

OF MECHANICKS.

THE word Mechanicks is thought by some to be derived from the Greek, intimating the efficacy and force of such inventions as elucidate geometrical rules for demonstrating motion, and the effects of power, or force, in removing the matter of bodies; or else because these arts are so full of pleasing variety, that they admit not of sloth or weariness. Indeed, according to the ordinary signification of the word, it is used in opposition to the liberal arts; whereas, in propriety of speech, those arts and employments may alone be called illiberal, which require some bodily labour, divested of causes and speculation; as sawyers, shoe-makers, tailors, &c. And on the contrary, that discipline, which teaches and discovers the general effects and properties of things, may truely be esteemed as a species of philosophy.

But here it should be observed, that this art is usually distinguished into a two-fold kind, viz. *rational* and *manual*. The first is that which treats of those principles and fundamental notions which may concern these mecha-

mechanical practices. The latter hath reference to the making of all these instruments, and the exercising of such particular experiments in architecture, &c. and, familiarly speaking, may be termed as theory and practice; both which I mean to treat of in the following sheets. The first of these may properly be called liberal, as deserving the thoughts of men of erudition; because springing from the honourable parentage of Geometry and Natural Philosophy.

Not even the pursuit of Rhetorick and Logick do more adorn the mind, than a thorough knowledge of Architecture, and mechanick powers and practices enlighten the understanding; and, therefore, are they well worthy to be entertained with much greater respect than they commonly meet with in these luxurious times.

The mechanical powers, by which all experiments are tried in removing the matter of bodies, are generally reckoned to be six—the Balance, the Lever, the Wheel, the Pulley, the Wedge, and the Screw; by some of which every divisible, impenetrable, and passive substance, that hath extension and resistance, which are the properties of all kinds of bodies, must be affected on their universal principle of gravity: gravity being that force, by which bodies are carried or tend towards the centre of the earth, and which may be said to be in proportion to the quantity of matter they contain.

But, for the better diſtinction, and more clear diſcovery of theſe mechanical faculties, as they are of the greateſt utility to all ſtudents of Architecture, I ſhall ſpeak of them ſeverally.

LECTURE II.

OF THE BALANCE.

THE firſt invention of the Balance is commonly attributed to Aſtrea, who was therefore deified by the title of the Goddeſs of Juſtice.

The particulars of the Balance are ſo commonly known, and of ſuch eaſy and familiar experiments, that they will not need any large explanation. The chief end of it is for the diſtinction of the ſeveral degrees of ponderoſity; for the underſtanding of which, we have only to note, viz. that, if the ſides of the Balance, and the weights at the end of them, be mutually equal, then the beam will be in an horizontal or level ſituation; but, on the contrary, if either the weights alone be equal, and not their diſtances, or the diſtances alone, and not the weights, then the beam will accordingly decline.

From theſe grounds, rightly apprehended, it is eaſy to conceive how a man may find out the juſt proportion of a weight, which, in any point given, ſhall equiponderate to ſeveral weights given, hanging in different places of the beam.

Within the power and circumscription of the Balance, many ingenious enquiries may be made; such as measuring the weights and force of blows, the strength of strings, or other oblong substances, the distinct proportion of several metals mixed together, and the different gravities of divers bodies in the water, from what they have in the open air. But as these are foreign to the present design, I shall conclude, without farther essay on the Balance, with this observation, that whatever geometrical definitions may be in any wise serviceable, relative to the Balance, I shall speak of them in the different parts of practice, as they occur; especially of geometrical stairs.

LECTURE III.

OF THE LEVER.

THE second mechanical power is the Lever, the first invention of which is generally given to Neptune, the God of the Sea, and represented by his trident.

The properties and principles of this powerful and useful instrument bear almost the same proportions with the Balance, only with this difference—mark the following

EXAMPLE.

As the weight is to an equivalent power, so is the distance betwixt the weight and the

centre unto the diſtance and the power; and ſo reciprocally. Or thus—The power that doth equiponderate with any weight, muſt have the ſame proportion unto it, as there is betwixt their ſeveral diſtances from the centre or fulciment.

The meaning of the foregoing example imports thus much; that the power at the end of the Lever muſt bear the ſame proportion to the weight to be ſuſtained, as the diſtance from the fulciment to the power you bear doth from the fulciment to the weight:—for inſtance, if your Lever be nine feet long, and the fulciment at one foot, the proportion will be as eight to one; for, ſuppoſing the weight eight hundred, one hundred borne upon the end of the Lever, at eight feet, would equiponderate, and be adequate to the weight. The ground of which maxim is, the fulciment at one foot, in this proportion, being the centre of gravity.

It muſt be obſerved, that all the varieties of motion in inanimate bodies, are ſubject to the forces impreſſed; and therefore it follows, if a body be abſolutely at reſt, and unfurniſhed with any moving principle, it muſt of courſe continue ſo, till acted upon by ſome external power. When a body is put into motion, it hath no power within itſelf to make any change in the direction of its courſe; therefore muſt move in proportion to the power impreſſed.

There

There is not a more uſeful, nor a more extenſive inſtrument than the Lever, nor any ſo familiarly reduced to practice. It is reported of the great Archimedes, that, with this ſimple inſtrument, he propoſed to remove the greateſt conceivable weight with the leaſt conceivable power; and moreover, that if he had but known where to ſtand and take his fulciment, he could have removed the world—this great maſs, or globe of ſea and land; which aſſertions, though altogether above the vulgar apprehenſion or belief, yet had his acts been ſo very extraordinary, that, in compliance with an edict made by the king of Syracuſe, (to believe whatever Archimedes ſhould affirm) they were obliged to aſſent to this extravagant propoſition; and though it were eaſy to demonſtrate the geometrical truths of theſe ſtrange aſſertions, yet where is the uſe of ſuppoſing them proved by the mechanical faculties? Such grounds, though palpable to the weakeſt capacity, could exiſt only in fancy, or idea, being far beyond the executive power of man to effect. Therefore the thought was truely extravagant, becauſe impacticable:—It is nevertheleſs certain, if there was the greateſt conceivable weight, with the leaſt imaginable power—ſuppoſe ſo ſmall as the weight of one man; if we conceive the ſame diſproportions between their ſeveral diſtances, as in the former obſervation, from the fulciment to the centre of gravity, they would both equi-

equiponderate: and if the diſtance of the power from the centre, in compariſon to the diſtance of the weight, were but any thing more than the heavineſs of the weight is in reſpect to the power, it may then be evident, from the former example, that the power would be greater than the weight, and conſequently able to move it.

LECTURE IV.

OF THE WHEEL.

AMONGST the variety of artificial motions, thoſe are of moſt uſe and pleaſure, on which, by the application of ſome continued ſtrength, a laſting motion is beſtowed. Theſe we may properly call ſelf-movers, becauſe the motions of ſuch inventions are actuated or cauſed by ſomething which belongs to their own frame, or at leaſt by ſome external inanimate agent; as mills by wind and water; clocks, watches, or other engines made of wheels, by weights, ſprings, &c.

It would be tedious to illuſtrate the extenſion of this mechanic faculty, otherwiſe than ſo far as may be uſeful to the preſent deſign. I ſhall therefore paſs over what may be effected by its ſubtlety, in every reſpect, but its power in removing the matter of bodies.

The Wheel, conſidered as relative to power, is in every reſpect equal to the Lever; but

but the force of this faculty may be more conveniently underſtood by the multiplication of ſeveral wheels together, with nuts belonging to each of them. The full effect of this invention cannot be better explained than thus:—As the nut is to the wheel, (which may be as one to ten) ſo is the number of wheels and nuts to an equivalent power. One of our ordinary jacks for roaſting meat (which conſiſt but of three) fully ſhews what may be executed by a number of theſe movers: for, if the fly or balance, in compariſon to its axis, be but as the proportion of wheels to the nuts, viz. ten to one, and the whole proportionable to the weight, it is evident that, if the weight was three hundred, a ſmall ſtring at the balance or fly would eaſily draw it up; for if the weight was three hundred, viz. 336lb. or even 1000lb. the fly need not be more than as one to a thouſand; for the firſt axis is to be but one tenth part of its wheel; and therefore, though the weight be a thouſand pounds, yet unto a power that hath this advantage, it is but as a hundred at the ſecond wheel; and in this proportion ſtill diminiſhing, at the third wheel it is but ten, and at the fly but one; ſo, if a man has a ſtring that will draw one pound, it is palpable he may effect this weight; and in like manner of any other power, let the weight or magnitude be ever ſo great; it is but adding more wheels and nuts, adequate to the above proportion.

Upon

Upon this principle was the famous engine extolled so by Stevinus, and preferred by him to all Archimedes': it consisted of wheels and nuts, though possibly more considerable in number, and might bear a greater proportion. Upon this principle an author tells us, that if there were an engine with 12 wheels, each having teeth, as also the axes or nuts belonging to them; if the diameter of these wheels were unto each axis as a hundred to one; and if we suppose the wheels to be so placed, that the teeth of the one might take hold of the axis of another, and that the axis of the handle (made to work it) turned the first wheel, and the weight were fixed to the axis of the last, he could then with ease remove the greatest conceivable weight in the world.

It appears to me, however, the most unaccountable thing in nature, how any man, or body of men, can buoy themselves up with impracticable notions: it is true, that explications and geometrical definitions may be given of all kinds of local motion, and those even so facile and obvious, that an ordinary artificer may sufficiently understand them, yet shall not all the men in the world be able to execute them. Though this may seem a paradox to many, I hope to prove it clearly by example; notwithstanding Aristotle has endeavoured to define, that there is no conceivable weight which may not be remov-

ed by these wheels, even as much acted as can be fancied by imagination.

It remains now, in order to make a perfect discovery of the truth of what many authors have asserted, concerning the removing the world, the drawing up by the roots the strongest oaks, and many more assertions of the like extravagant kind, to enquire into the nature of artificial motion—I mean slowness and swiftness; for, without a right understanding of these, a man will be exposed to many absurd mistakes, in attempting matters, which are either in themselves impossible, or else not to be performed by such means as are applied to them. I think I may safely affirm, that many, if not most of the mistakes in these great mechanical designs, arise from a misapprehension of that difference which will be between the slowness or swiftness of the weight and power, in comparison to the proportion of their several strengths.

Now if it were possible to contrive an engine, whereby any conceivable weight might be moved by any conceivable power, both with the same brevity or speed (as it is with those things immediately stirred by the hand) the works of Nature would be then too much subjected to the power of Art, and men might be encouraged, in imitation of the builders of Babel, to such extravagant designs as would not become a created being; the wisdom of Providence therefore hath so confined these human arts, that what any

invention

invention hath in ſtrength, is abated in the ſlowneſs of its motion: for it is to be obſerved as a general rule, that the ſpace of time or place, in which the weight is moved, in compariſon to that in which the power doth move, is in the ſame proportion as they themſelves are to one another; ſo that if there be any great difference between the ſtrength of the weight and the power, the very ſame kind of difference will there be in the ſpace of their motion. For inſtance, if the power be unto the weight but as one to an hundred, then the ſpace, through which the weight moves, will be an hundred times leſs, and conſequently the motion of the weight an hundred times ſlower than that of the power.

If we conſider an inſtrument of twelve wheels, as before-mentioned, made proportionable in ſtrength to any imaginable weight, we ſhall then find that its motion will be conſiderably ſlower than the heavens are ſwift; for, if we ſuppoſe the windlace to ſuch an engine (prepared to ſet the whole in motion) to be turned 4000 times in an hour, yet in ten years ſpace the weight will not be moved one hair's-breadth, nor one inch in a thouſand years: the truth of this will be more eaſily conceived, if we conſider the frame and manner of a twelve-wheeled engine: ſuppoſe in each axis or nut there be ten teeth, and on each wheel a thouſand; then the windlace of this engine muſt be turned one hun-

 dred

dred times before the firſt wheel, reckoning downwards, can be moved round once, and ten thouſand times before the ſecond can finiſh one revolution; and thus through the whole twelve wheels in this multiplied proportion.

I will now appeal to every reader, of common reaſon, whether ſuch attempts or expreſſions can be any thing more than the incoherencies of a diſtempered brain! For notwithſtanding the beauties of mechanical manœuvres are as inſtructing as entertaining, when reduced to familiar practice, yet when once proſtituted, or ſtretched beyond the power of art, they can no longer be conſidered as parts of the ſcience, becauſe they exiſt only in imagination.

Not much unlike theſe extravagant notions was that of the famous Grecian architect, who propounded to Alexander the Great, to cut mount Athos into the ſtatue or figure of a man, which in his right hand ſhould hold a town capable of containing ten thouſand men, and in his left a veſſel to receive all the water that flowed from the ſeveral ſprings in the mountain; but whether Alexander, in his ambition, feared that ſuch an idol might have more honour than he himſelf; or whether, in his frugality, he thought ſuch a work would coſt him more money than conquering the world; or whatever elſe was his motive, he refuſed to undertake it: but if he had conſented to ſuch an extravagant attempt, (though

(though in contradiction to the opinions of all mankind) I dare affirm it never could have been executed.

LECTURE V.

OF THE PULLEY.

THE Pulley is of ſuch ordinary uſe, that it will not need much, nor any particular deſcription. The chief parts of it are divers little rundles, which are moveable about their proper axes: theſe are uſually divided according to their ſeveral ſituations, into the upper and lower. The lower pullies only give force to the motions. If we ſuppoſe a weight to hang upon any of the upper rundles, it will then require a power, which in itſelf ſhall be fully equal to the ſuſtaining it.

The diameter of a pulley, when fixed in a ſtate of motion, is as a proper beam or balance hung upon its centre: therefore the power muſt be adequate to the weight, in the ſame ſtate as if the power and weight were faſtened by two different cords, at the end of the balance. Now all the upper pullies being of one and the ſame nature, it muſt neceſſarily follow, that none of them in themſelves conduce to the eaſing of the power, but only to the greater conveniency of the motion; the cords by this means being more eaſily moved than otherwiſe they would

would be. If the weight to be sustained be above the pulley, as in all the lower sorts it is, then the power that supports it need be but half the weight itself. For example, let the diameter of a lower pulley, on whose centre the weight is fastened, be equal to ten pounds, one end of the cord being tied to a hook, there will be but half the weight to sustain; for the hook in this case is the same as if held up with a string, with one end in each hand, upon a proper balance; and this subduple proportion will still remain, though an upper pulley be joined to the lower. The upper pulley alone doth not abate any thing of the weight: it is the same thing, whether the half-weight be sustained equal to the hook by which one end of the cord is fastened as the weight is altered by the lower pulley alone. Now, as one of the lower pullies doth abate half of that heaviness which the weight hath in itself, and cause the power to be in a subduple proportion unto it, so two abate the half of that which still remains, and cause a subquadruple proportion between the weight and the power; three a subsextuple; and so on to as many as may be required: for they will still diminish the weight according to this proportion. Suppose the weight then in itself to be 1000lb. the applying it to one of those lower pullies will make it but 500; two of them but 250; three of them 125, &c.

It is not material to the force of this inſtrument, whether the rundles be big or little, provided they be made equal to one another, in their ſeveral ſtations. But it is moſt convenient, that the upper ones ſhould each increaſe as they are higher; becauſe by this means the cords will be kept from tangling: theſe pullies may be multiplied according to ſundry ſituations. By theſe examples an invention is eaſily formed, for a man to draw himſelf up to any conceivable height; and familiarly reduced may be of much ſervice for particular uſes, as when occaſion requires the reperation of cielings, towers, domes, cathedrals, &c. and this may be effected with ſo little trouble and expence as two pullies, one above, the other below; to the upper one muſt be fixed a hook, hung at the top, which may be done on the outſide: the end of the cord being fixed to the centre of the top pulley, and put firſt round the bottom rundle, then the top; the other end of the cord a man may have in his hand to draw himſelf up by, or to any machine that he may require for his tools, &c. The execution of this will require but little more than half his weight, or if the pullies be multiplied, it may be done with half that force, and ſo on in the aforementioned proportions.

From what hath been ſaid of pullies, it is eaſy to conceive, what great performances may be wrought by theſe powers being inſtruments

ments of infinite ſtrength: it is reported of Archimedes, that with an engine of pullies to which he applied only his left arm he lifted up 5000 buſhels of corn at once; and drew up a ſhip with all her lading upon dry ground; and all this with a threefold pulley. But it is not poſſible that theſe alone ſhould ſerve for the lifting of ſuch a weight; becauſe ſuch an engine can make but a ſubſextuple, or at moſt a ſubſeptuple proportion, between the weight and power: which is by far too little to reconcile the ſtrength of a man to ſuch ponderoſities.—How many of theſe miſtakes were it eaſy to find out, if we did but know the weight of thoſe ancient meaſures: ſuppoſing them to be the ſame with our Engliſh buſhel, which weighs 64 pounds, the whole would then amount to 320,003 pounds, one half of which would be lightened by the firſt pulley, half of the remainder by the ſecond; and ſo on in this ſubduple proportion. And if we conſider a man's hand to be as 50 pounds weight, it is demonſtrable that it will then take at leaſt ten or twelve pullies to effect it.

LECTURE VI.

OF THE WEDGE.

THE firſt mechanical faculty is the Wedge, a well known inſtrument, and of the greateſt utility in niedling up old houſes, cleaving of wood, &c. The efficacy

and great ſtrength of it may be reſolved and particularized,

Firſt, by the form of it,

Secondly, by the manner whereby the power is impreſſed upon it; which is by the force of blows, or percuſſion.

Firſt, the form of it repreſents two levers; and it is a general rule, that the more acute the angles are, ſo much the more eaſy will be their motion; the force, from the acuteneſs of thoſe angles, being more eaſily impreſſed, and the ſpace wherein the body is moved ſo much the leſs.

The ſecond particular whereby this inſtrument hath its force, is the manner whereby that force is impreſſed upon it; which is by a ſtroke or blow. The efficacy of it alſo far exceeds any other; for though we ſuppoſe a wedge to be laid or fixed in a piece of timber (in a poſition for cleaving) and preſſed down with ever ſo great a ſtrength, nay, though we were to apply the force of the other mechanical inſtruments, the ſcrew, pulley, &c. yet the effect would not be adequate to a blow. The true definition therefore of this is perhaps one of the greateſt ſubtilties in nature, nor is it in my opinion fully explained by any author who has undertaken its reſolution: though to me it ſeems no other than the celerity of the blow given to effect it.

Thoſe who attribute it to velocity alone, have not given a proper definition of it; for if this were

were true, a blow given with a light weapon would exceed any other force. And according to this, how comes it to paſs that an arrow or bullet diſcharged near at hand, is much leſs forcible than at a proper diſtance; whereas the violence whereby they are carried at firſt is neweſt, and in all probability the motion at that time the moſt ſwift; The firſt and greateſt conſideration ſeems to me the quality and weight of the inſtrument by which the blow is given; and ſecondly, the ſpace or diſtance through which it paſſes.

And firſt, If the inſtrument by which you mean to effect the motion, be not proportionable to the ſtrength or force required, the ſwiftneſs or rapidity of the blow will not ſerve to accompliſh it. Secondly, If the ſpace or diſtance through which the force muſt paſs be not ſufficient for it to acquire the requiſite celerity, it will add nothing to the effect that the ſledge or inſtrument contain a double proportion of weight; and therefore may be reduced to the following example: as the weight of the inſtrument is to the power of the wedge, ſo is the celerity of the blow to the diſtance required to effect it.

LECTURE VII.

OF THE SCREW

THAT which is uſually eſteemed the ſixth mechanical power is the Screw; which may be called a kind of wedge, multiplied or continued by an Heliacal revolution

round about the body of a cylinder; receiving its motion not from a ſtroke, but a lever or handle at one end of it; and uſually diſtinguiſhed by the names of a male and female. The male is the fore-mentioned ſcrew; the female the nut which receives it. The quality of this power far exceeds any of the reſt, for thoſe uſes for which it is generally applyed; as, in printing, extracting and ſqueezing out the juice of fruits, &c. and in the working of this inſtrument the ſtrength of one man will be more forcible than the weight of a whole mountain. It is alſo uſed for lifting and raiſing great weights, and is much more practicable than any inſtrument made of wheels, pullies, &c.

The great advantage of this faculty above the reſt conſiſts chiefly in this; the other inſtruments require as much ſtrength for the ſupporting of the weight to be moved as may be equal to it, beſide that other ſuper-added power whereby it is out-weighed and moved; ſo that in the operation by theſe a man always exhauſts himſelf by continued labour. For example:

Any weight that is lifted by a wheel or pulley, will of itſelf recline, if there be not an equal power to ſuſtain it: but in the formation of the ſcrew, this inconvenience is perfectly remedied; for as much force as is communicated unto this faculty from the power applied to it, is ſtill retained by the very frame and nature of the inſtrument itſelf; ſeeing

ing the motion cannot return, but by the handle of the lever which effected it; ſo that the whole ſtrength of the power may be employed in the motion of the weight, and none ſpent in ſuſtaining it. The principal defect of the ſcrew is, that in a ſhort ſpace it will be worked to its full length; and then it cannot be of further uſe for the continuing of the motion; unleſs (as before obſerved) it be returned back by the ſame inſtrument that worked it.

Though this moſt noble and eaſy of all mechanick powers be not ſo much as mentioned by ſome of the ancients, eſpecially *Ariſtotle*; yet I cannot help thinking, that moſt of the wonders performed of old may chiefly be attributed to the execution of this inſtrument, becauſe no other invention could be ſo applicable to time, as what might be made and contrived by certain ſcrews.

Among the *Jews* we read of *Solomon's* temple, which for its ſtate and magnificence might have been juſtly reckoned among the other wonders of the world: we read of pillars of braſs eighteen cubits high, and twelve cubits round, great and coſtly ſtones for the foundation of it. *Joſephus* tells us, that ſome of the ſtones were forty-five cubits long: and in another place mentions the famous towers built by *Herod*, wherein every ſtone was of white marble, twenty cubits long, ten broad, and five thick; and which was the greateſt wonder, the old wall itſelf ſtood upon a ſteep

rising ground, with the hills upon it, on the tops of which these towers were built, which were above thirty cubits high; so that it is scarce conceivable by what strength so many stones, of such great magnitude, were conveyed thither.

Among the *Grecians* we read of the *Ephesian* temple dedicated to *Riana*, wherein were an hundred and twenty-seven columns, formed of as many stones, each of them sixty feet high, and all taken out of the quarries of *Asia*.

Further, there were at *Rome* sundry obelisks, each composed of so many entire stones, some of which were 40, some 80, and others 90 cubits high; most of these were brought out of the quarries dug in *Egypt*; where they were wrought into form, and afterwards, not without incredible labour and infinite charge, brought to *Rome*.

Also about two hundred years ago an old obelisk was erected, which had been dedicated to *Julius Cæsar*: this was one intire stone, being a kind of spotted marble; the height of it one hundred and seven feet; the breadth at the bottom twelve feet; and at the top eight: it was removed at the charge of Pope *Sextus* the Fifth, from the left side of the Vatican to a higher ground. The moving of this obelisk is celebrated by many writers; all of whom speak of it with great wonder and praise.

The executing in former days such great wonders may seem to infer, that their mechanical arts are now lost among the many other ruins of time; but this cannot by any means be granted, without much ingratitude to the present age.—I believe if a proper examination were made into the merits of some now living, I am not persuaded we should find it a want of method that disables them; but because we have not either the same materials, or motives to attempt such works, or the means to effect them, as the ancients had.

The present age is much more active than that of the ancients; every man finds so much business for the present, that he has not leisure to trouble himself about things which can never be of use to him, and therefore in many respects there is a great disproportion betwixt the incitements of former times, and those of the present age with respect to such magnificent attempts. As we differ also much in the motives, so likewise do we in the means of effecting them.

In those remote days there was more leisure and opportunity both for great men to undertake such works, and for the people to perfect them: whereas the world is now grown more politick and therefore more troublesome: every great man having other private and necessary business about which to employ his time and fortune. So likewise in regard to the common people, who living at that time more wildly, without being confined to particular

ticular trades and professions, might be more easily collected upon some famous employments: whereas now, if the king wanted to raise an army, it would not be possible to gather half the number of men that were formerly employed about these magnificent buildings.

We read of thirty-six hundred thousand men being busied for twenty years in building one of the Egyptian pyramids; for a million that were as long in building another; and about the carriage of one stone only twenty days journey, on which for three years together two thousand chosen men were directors, besides many other under-labourers.

In the building of *Solomon's* temple there were threescore and ten thousand that bare burdens, besides fourscore thousand hewers in the mountains. Supposing every one of these but to carry a load, there were enough to make a large mountain.—The *Ephesian* temple, spoken of before, was built at the joint expence of all *Asia*; the 127 pillars in it were made by so many kings, according to their several successions; the whole work not being finished in less time than two hundred and fifteen years.

The abundance of wealth which was then in the possession of a few individuals being now diffused among a far greater number, there is at present a greater equality among mankind; and the flourishing of arts and sciences hath so stirred up men's natural nobility,

lity, and made them of ſuch active and induſtrious ſpirits, as to free themſelves in a great meaſure from that ſlavery which thoſe old and unpoliſhed nations were ſubject to. From all which conſiderations it does not follow that there is any defect of art in theſe latter days. For my own part, I conceive it eaſy to demonſtrate the mechanical arts in theſe times to be ſo far beyond the knowledge of remoter ages, that had we but the means the ancients had, we would effect far greater works with half the labour they uſed, and one tenth part of the expence.

LECTURE VIII.

OF BUILDING IN GENERAL.

THOUGH the word Building in a reſtrained ſenſe alludes only to the erecting or raiſing of an edifice; yet the means and manner of ſuch erection muſt be effected by the power of ſcience, well digeſted in the mind of the conductor. For to build well, depends not only on the ſciences of Geometry and Architecture, but alſo on a thorough knowledge of the mechanick powers in general; as well as on Hydraulics, or the art of conveying water by the law of motion, through pipes or engines, in ſuch manner as may be requiſite both for uſe and convenience.

The art of building then, which is founded on the requiſite of ſome of the nobleſt ſciences,

ſciences, requires a greater application, and more enlarged judgement, than is uſually conſidered: from whence it follows that the term builder is frequently made uſe of, and miſapplied by ſome who do not underſtand it. For a man to be a proficient in building, in the firſt place he ſhould have a knowledge of all the materials to be uſed, both in reſpect to quality and quantity, as well as all the arts of the different branches thereunto belonging: with many more relative conſiderations. Plainly to elucidate theſe requiſites as far as may be neceſſary with common practice, in civil architecture, is the ſubject of the following ſheets; and becauſe I wiſh not to take up my reader's time with a deſcription of what he has to obtain, without an illuſtration of the principles themſelves, I ſhall proceed, in the firſt place, to explain the principles of Building in general.

In every ſtructure or edifice four things are to be conſidered, viz. ſtrength, convenience, propriety, and beauty; without theſe no choice of any quantity of materials whatſoever will in any wiſe contribute to the purpoſe; as nothing can be erected with any certainty, that is wanting in the above properties. It will be ſuitable therefore to our deſign, not only to enquire into the nature of theſe great conſiderations, but alſo to elucidate their uſe, and point out ſuch defects as the unexperienced workman may be liable to.

LECTURE IX.

OF STRENGTH IN BUILDING.

THE first quality to be considered in all buildings is Strength; this directly alludes to the ground-work, in every respect and part; which a builder should have a firm assurance of, before the first stone or brick is laid: for whatever errors may be committed in a building they cannot in any wise be so pernicious as a defect in the foundation. It behoves every man therefore, who is principally concerned in an edifice, to look and inspect into this great particular himself; it being the base of the fabric, he should be well assured of its natural solidity. If the ground be faulty, in that case it will be necessary to supply this natural defect by the power of art, which may be done equal to any strength required.

A natural foundation is that which may be built upon without the assistance of piles, timber, plank, &c. There are different sorts of ground which may be built upon, and all equally good; such as stone, clay, gravel, and chalk. These, if the foundation be of size proportionable to the weight to be sustained, will answer every purpose.

An artificial foundation is that which is obliged to be made when the ground is loose, rotten, or otherwise defective, by the help of piles or planking, and must be indifferently

ufed according to the builder's judgement. If the ground be a loofe fand, and ftand upon water but a fhort fpace from the furface of the ground, or floor of the cellars, (if fuch are built) it will be neceffary to drive piles all along the different foundations, as clofe as they can ftand, efpecially at all angles, quoins, and chimnies. With regard to the length of the piles, they muft always be regulated by the ftrength or body of the earth, and the weight and magnitude of the fuperftructure. — For my own part, I would always choofe to make piles of fuch a length as might reach to a folidity of foil. The fcantling of piles may be as 1-14th part of their length. With regard to inner walls, it may not in every cafe be required to drive piles quite clofe all along but at three, four, or five feet apart: between which lay bridgings of oak, and planking may be placed upon the whole.

There are fome parts of ground where planking alone may do, and which are not of confequence fufficient to be trufted without. In fuch cafes the following method muft be adhered to.

Firft, Level the ground at the bottom of the trench, and at every quoin, and betwixt, at the diftance of three feet, lay bridgings of oak the whole width of the foundation. Between and level with the top of thefe lay bricks or ftones with planking of three or four inches thick, to cover the whole; and on them proceed,

proceed, obſerving to bed well the planking with good loam, that the wood-work may lie ſolid along, and likewiſe particularly level.

The benefits which ariſe from a level foundation are, I hope, obvious to every profeſſor of building: for this is not only a guide to keep in that ſtate all the way up, but a ſhrewd maxim, that when this example is ſtrictly adhered to, (and the materials of a proportional weight) its bearings upon the ground are equal; and if any ſettlement ſhould enſue, it may then be every where alike.

With regard to inner walls, it is highly requiſite that the like care be taken; for a ſure and level foundation is of as much conſequence in them as in the outward walls; and though they will require much leſs, yet muſt they be ſecured in proportion to their ſeveral weights: for if ſettlements ſhould happen within the houſe, the whole maſs of decorations will be diſconcerted, and rendered defective to every eye.

The foundation being thus ſecured, we are next to conſider the other appurtenances of ſtrength, viz. the walls, centring-groins, floors, bond-timbers, lintels, diſcharging-pieces, taſſels, plates, girders, roof, tie-beams, &c. which muſt all bear a proportion to one another, and in every reſpect adequate to the whole.

And firſt of walls, whoſe great principle of ſtrength lies in the peculiar cauſe of their erection,

erection, which is to ſupport a certain weight to be appropriated, and therefore of courſe muſt be made ſufficient for the purpoſe intended. In order to reduce this ſyſtem to a certainty, we muſt firſt be acquainted with the height and width of the ſtructure, by which means we ſhall be able to fix a ſtandard for the thickneſs of walls. But as this laſt obſervation comes within the limits or rule of propriety, I ſhall finiſh this lecture with the following obſervation, viz. That after the foundation is ſecured, to continue this quality of ſtrength the walls muſt be all built perpendicular; for then they are in their full poſitions of ſtrength. The timbers muſt likewiſe be all of ſufficient ſcantlings, proportionable to the ſize of the building, and have ſufficient lengths of bearings in the walls, the bond-timbers being all bound in the angles and fixed, till the roof is on, in one continued chain round the building; the girders every one laid upon piers if poſſible, with binding pieces of timber underneath, and centres of brick turned over the tops of them: and if the girders be of great lengths they muſt alſo be truſſed.

The roof muſt be ſo contrived that all the walls may bear a proportionable ſhare, neither too heavy nor too light. If too heavy, the lateral preſſure of the rafters will tend to ſhove out the walls: if too light, it muſt of courſe be in danger from every ſtorm. The raiſing-plates muſt be well tied at the angles, and the

the whole building ſecured at proper places with tie-beams, &c. And to crown the work with ſtrength, the walls ſhould have ſufficient time in building, leſt the ſuper-incumbent weight cruſh the work beneath, and cauſe premature ſettlements, the ſure way to ruin and deſtruction.

LECTURE X.

OF CONVENIENCE IN BUILDING.

THE word Convenience hath an extenſive meaning, and imports, that a building ſo contrived ſhould be advantageous, warm, pleaſant, and uſeful, according to the intent propoſed, the perſon you build for, or uſe to which it is appropriated.

If a perſon of rank builds, for ſuch the architect ſhould be particularly circumſpect in regard to the ſituation, and take every advantage to obtain the moſt pleaſing effect, both as to place and proſpect; eſpecially in the country, where there generally is room enough for invention, and no check upon the fancy, or reſtraint to the moſt pregnant genius, in embelliſhing his deſign with every beauty of art and nature, ſuitable to the perſon and adequate to the place. In town, things of this nature cannot in every reſpect be adhered to, as we are frequently confined in our mode of building through the inconvenience of the place, and therefore cannot ſo eaſily ſtrike upon that happy groupe of con-

ſiſtencies, which, when properly united, will ever render a ſtructure pleaſing, of whatever ſize or dimenſions it be. However, if a place can by any means be obtained for the purpoſe, I would recommend for a perſon of rank a wide airy ſtreet contiguous to ſome ſquare, with a ſufficient number of avenues leading to public places, that no danger or hinderance might ariſe by the meeting of carriages.

When ſuch a place is fixed upon, care ſhould be taken in the deſign, that the exterior parts of the building have ſomething more diſtinguiſhing than the common mode, both as to form and execution, and not inferior to the rank of the perſon you build for. The interior part ſhould be eaſy, connected, and ſuitable to their different purpoſes. The ſtairs contrived in a familiar place, and in the midſt of the rooms above and below, that an eaſy entrance may be had to every apartment. The anti-chamber alſo ſhould be as convenient as poſſible to the ſtairs, that ſtrangers may not be incommoded. The bed-chambers neither too large nor glaring with light. The back-ſtairs ſo contrived, that ſervants may paſs to their own apartments and places of buſineſs without impediment, from the beſt rooms; and that water-cloſets be conſtructed in proper places, and without the leaſt annoyance; the ceſs-pools and drains made of a ſufficient magnitude; water had

familiar

familiar to the kitchen, and every thing that can be obtained with respect to prospect from the windows, &c. to render the whole pleasant, useful, and in every respect adequate to the intent.

The same rules should be observed in every other building, whether it be for a merchant, trader, or manufacturer. First, the necessary appurtenances must be noticed; then what else of beauty may be thought consistent with the design must be added, with this main point in view, not to out-stretch the purse and intent of your employer.

LECTURE XI.

OF PROPRIETY IN BUILDING.

THE term Propriety is not so much as mentioned by *Andrew Palladio*, nor any author extant; all hitherto having contented themselves with thinking that whatever is beautiful must be proper. But this I deny; and want no greater vindication of my dissent than a thorough examination into the present ludicrous mixture of fragments, which are all esteemed incomparable beauties, though in reality they have not one property to recommend them.

It is contrary to my plan or intent, to depreciate the designs of any surveyor, or private workman; but I must point out the common errors of the age, lest the young and inexperienced should snatch the gorgeous bait,

and imbibe ſuch a puerile ſyſtem of inconſiſtencies as may take them more time to eradicate than leiſure to acquire. — Now though there are many very elegant deſigns which border upon, or rather were the originals to the preſent ſhades of what is called Taſte; yet thoſe abound in moſt of the merits which I define to be propriety, which is the exact bounds fixed for the finiſhing all ſorts of work, and the real ſubſtance of judicious experiments, that have been made by altitudes and geometrical calculations, to find the moſt approved proportions of unity which one member bears to another in an indiviſible ſtate; ſo that ſtrength and beauty may be circumſcribed by its power, and have a certain criterion or limit for their extenſion.

To attain a right underſtanding of this is one of the firſt principles that ſhould attract the attention of every ſtudent or profeſſor of building; for it is the only guide to perfection, and without it no proficiency can be arrived at. In many buſineſſes and employs propriety is no more than the reſult of fancy, which hath a change or different effect upon almoſt every eye. But building is not ſubject to this mutable ſtate; for when once a plan and elevation is given, and its intent and conſequence known, the judicious workman of himſelf ſhould proceed without the aſſiſtance of architect or ſurveyor. By one who is well apprized and ſtudied in the principles of building, every part and principle of a build-

ing

ing may be reduced to a ſyſtem, and hold ſuch an affinity with nature, that harmony and arrangement may be ſeen through the whole, light and eaſy, and yet ſubject to the ſtrict rules of architecture.

This many of our men of modern notions will not believe, becauſe they will allow nothing magnificent that is not compoſed of the preſent jargon of mutabilities.

I muſt confeſs I am far from conſidering the ancients or their ſenſe of building as in the leaſt compatible with the natural and ſplendid eaſe we ſee in many of our modern productions. The ſeveral ages of improvements, and different eſſays in every century, muſt have made ſome progreſs for the better, or their works and labours would have deſerved ſevere criticiſm. However, it cannot be affirmed, that the five orders of Architecture have received the leaſt addition for many ages: their compoſitions are ſo judicious, natural, and ſtriking, and bear ſuch a proportion with reaſon, that is has ſurpaſſed the abilities of every commentator, either to add or diminiſh, without eclipſing the beauty of the whole.

Many have attempted this great undertaking at this time, and daily leave laſting ſpectacles of their weakneſs and judgement. This is done with an intent (as they call it) to lighten the orders; the projection of their different members being by far too heavy for the ſplendid work of the times. But herein

is their miſtake; for I will be bold to affirm in the preſent caſe, that whatever is taken from the projections adds weight to the whole in a double proportion. In order to prove this, I will only deſire my readers (if they are unacquaited with this great matter) to make two drawings of any of the five orders of Architecture; one according to the projections and dimenſions of *Scamozzi*, *Palladio*, &c. and another with the projections of the preſent times, and you will find the laſt mentioned will be much the heavieſt: for it is a ſhrewd maxim in Architecture, that whatever is added to the head takes from the weight of the body. I have ſeen others, in order to take off the weight incurred by reducing the projections, add one diameter more to the ſhaft, and the like addition to the pedeſtal. But this was mending the matter with a witneſs; for then they were under the ſame predicament with reſpect to the height of the mouldings; and in order to remedy one defect, plunged into numberleſs abſurdities.

The proportions of the orders are of ſuch ſenſible magnitudes that nothing artificial can ſurpaſs them. I ſincerely wiſh, that every profeſſor of Architecture was convinced of this; for inſtead of gaudy, we ſhould then ſee magnificent productions; and for arts and ſciences, juſtly vie with the world, and bid the greateſt nation defiance.

I do

I do not mean by what I have advanced to aſſert, that an Architect ſhould be confined to produce nothing but the works of the ancients. No; I muſt beg my reader to underſtand, that I have the greateſt veneration for taſte and improvement, and hold that to be the great ſupport of the individual: but I would not extend this beyond the rule of propriety; I would not, becauſe it is the faſhion to wear a club to my hair, ſtretch that beyond the bounds of reaſon, to the enormous ſize of my leg; nor, becauſe it is the taſte of the times, to make ſmall cornices and large frizes to my rooms, to be in the very pink of the mode, make all friezes and no cornice at all, which, to the diſgrace of beauty and propriety, is now almoſt the caſe. There is a ſenſible medium or ſtriking effect in all the works of art, like the perfection of nature, which cannot be exceeded. But this is within the limits of beauty, which I ſhall mention hereafter: wherefore I ſhall only propoſe a ſtandard for the propriety of walls, the conſequence of light, ſize of chimnies, &c. and then give ſome obſervations on the beauties of building. — What proportions of unity the preſent taſte of building has or will bear with propriety, I ſhall mention in my criterion of practice ſeparately as they occur.

Of the Standard of Walls, &c.

And, firſt, of the ſize or thickneſs of walls, and depth of foundations, which chiefly depend on the height of the ſtructure, weight of the materials, &c. For the depth of foundations different authors allow one ſixth of the height of the building. But this I think unneceſſary; and inſtead of one ſixth, it may be one eighth part of the entire height of the ſuperſtructure: the breadth of the foundation three fourths of its depth: the firſt ſtory two thirds of the foundation at the bottom, and from that diminiſh one half brick every ſtory upwards. This I have found in the courſe of my own experience to be the beſt ſtandard that can be calculated; though even this has its exceptions in peculiar caſes, as when the foundations are bad, and the conſequence of the building will not afford a ſufficient natural foundation to be made. In ſuch a caſe the ſize of the foundation may be augmented at the diſcretion of the builder. Obſerve however, that the foundations ſhould diminiſh upwards, and that regular ſet offs ſhould be made on both ſides, ſo that a perpendicular line may be drawn through the foundation and middle of the wall at the top of the building, that ſolid may reſt upon ſolid.

There are many ſurveyors and builders who argue againſt regular ſet-offs on the outſide of a building, alledging, that they are only receptacles for water, and as ſuch oftentimes preju-

prejudicial to the ſtories below. But theſe are weak arguments, when compared to the ſtrength of the building, which muſt be defective when ſet-offs are only made on the inſide. The eaves and cornice prevent any water lodging upon the facios, &c. on the outſide, except what happens by a lateral ſhower, which is very rare, and too trifling to be noticed.

I muſt confeſs, it has been the caſe in moſt of the new buildings about town to make no ſet-offs on the outſides for ſome time; but in this the builders greatly miſtook their intereſt, (eſpecially thoſe who built for ſale) as a houſe properly ſet off on both ſides will not require to be ſo ſtrong by one ſixth of the quantity of materials, which amounts to a conſiderable ſum in a large building.

The next point of propriety is the height of ſtories, and their order, which ſhould diminiſh upward, though in ſome particular caſes they cannot, as when the moſt magnificent rooms are appropriated to the ſecond or third ſtory: where this happens, great care muſt be had of the foundation, and ſomething more added to the ſtrength of the walls in the lower ſtories.

Of the Propriety of Chimnies.

In the conſtruction of chimnies care ſhould be taken to erect burrs in the foundation for the piers, leſt the ſuper-incumbent weight cauſe deſtructive ſettlements; that the open-

ings

ings of the chimnies be proportional to the ſize of the rooms, and the funnels made proportional to the openings: by theſe means there is good probability of being relieved from that great diſturber of peace in a family, a ſmokey chimney. This particular was quite unknown to the ancients; even *Palladio* only gueſſed at its properties. One would think that practical experiments would long ago have reduced this ſyſtem to a certainty; but, alas! we are ſtill in the dark, and may continue ſo, and leave it to be found out by the next century.

The beſt calculations I can make for chimnies, and which in general I have proved to be anſwerable in almoſt every caſe, are by the following table adapted to the ſize of all the rooms that may occur in common practice.

The reader will obſerve that this table is calculated from rooms ſuppoſed to be ſquare. When a room is otherwiſe, I bring it ſquare in the following manner: Add the length and breadth together, and take half for the ſquare of the room. For example: If a room be 14 feet by 10, add them together, and they make 24; look for 12 the ſquare of the room in the table, and you will then find the height of the opening to be 3 feet 3 inches, breadth 2 feet 6 inches, and depth 1 foot 5 inches, and ſo of all the reſt.

The method of finding the depth of chimnies is to add the height and breadth together, and take one fourth for the depth.

For

For Example:

Supposing to the above dimensions of 3 feet 3 inches by 2 feet 6 inches, I set them down as in the margin; this will make 5 feet 9 inches, one fourth of which is 1 foot 5 inches, the exact depth of the chimney.	Ft. : In.
	2 : 6
	3 : 3
	5 : 9½
	1 : 10⅞ the size.

The proportion of the funnels is got from the depth of the chimnies, and should be always three fourths of the chimney's depth for the square of the side.

A Table of the Size of the Openings of Chimnies.

Square of Rooms.	Breadth of the Opening. Ft.	In.	Height of the Opening. Ft.	In.	Depth of the Chimney. Ft.	In.
6	1	6	3	0	1	1½
9	2	0	3	1½	1	3¼
12	2	6	3	3	1	5
15	3	0	3	4½	1	7⅛
18	3	6	3	6	1	9
21	4	0	3	7½	1	10⅞
24	4	6	3	9	2	0¾
27	5	0	3	10⅜	2	2⅝
30	5	6	4	0	2	4

In order to supply the defect of strength which every opening occasions, discharging pieces

pieces of timber ſhould be laid acroſs the breaſt to take off the weight: in the end of the breaſt muſt be laid returning pieces, or what is called taſſels, which are of infinite ſervice. If the building be within the bills of mortality, and no taſſels or diſcharging pieces can be applied without incurring the danger of the penalty, arches of brick muſt be turned in the breaſt to anſwer the purpoſe.

Of Windows and their Openings.

The openings of windows have been as little enquired into as the ſize of chimnies, although of material conſequence; for if a room be too glaring with light it is as defective as if it had too little: a ſtandard of propriety therefore ſhould be attained, in order to render this agreeable ſenſation as pleaſing as poſſible. However an error committed in this particular may be more eaſily diſpenſed with, than the offenſive evaporation of ſmoke. The following is a general rule.

Let the dimenſions of a room be given, viz. Length, breadth, and height: Multiply the length and breadth together, and the product by the height, the ſquare root of the laſt product will be the quantity of light required. For example:

Suppoſe

Suppose a room were 19 feet by 14, and 12 feet high, I first multiply them as in the margin, the length by the breadth, and the product by the height, and extract the square-root of the last product, which gives 56 square feet, the real quantity of light required.

```
      19
      14
     ----
      76
     19
     ----
     266
      12
     ----
    ·  ·
  | 3192 | 56
    25
    ----
106 | 692
      636
     ----
       56
```

The next thing is to dispose or appropriate the light into a number of windows. In the above case, for a room of 12 feet high a window should be about 8 feet. The 56 divided will make 28 feet each; for two windows which will answer the dimensions of 8 feet by 3 feet 6 inches, and be adequate to the intent. The same likewise of any other dimension whatever.

LECTURE XII.

OF BEAUTY IN BUILDING.

THE engaging enchantress Beauty is of a noble descent; her kindred are all famous in building, both in plans, elevations, and

and ſections. She is the elder ſiſter of Taſte, begot of Elegance by Propriety. Such an extraordinary character ſhould produce ſtriking effects, which certainly is the caſe when her votaries purſue her ſteps with dexterity.

The peculiar graces which are attributed to Beauty, are freedom, eaſe, and perſpicuity, which in reality are ſo connected that no ſeparation of them can be obtained without deſtroying their effect.

If a man would arrive at a proficiency in this article, he muſt firſt ſtudy the three before-mentioned qualities, viz. ſtrength, convenience, and propriety, before he can be a judge of it: for this much is certain, a building may be ſtrong, convenient, and even abound with proper inſtructions and juſt dimenſions, and yet not poſſeſs one of theſe rare embelliſhments.

Some of my readers may perhaps be at a loſs to know what I mean by Beauties; where they may be applied; of what they conſiſt, and how to be attained. It may not be amiſs therefore to hint at its properties; though ſuch an analyſis would require the pen of the greateſt proficient of ſciences, yet have they hitherto paſſed it over as trivial, without that copious deſcription which the ſubject naturally requires. I muſt confeſs, I ſhould be extremely glad if my giving a few hints could animate ſome abler pen to elucidate this quality in its ſtriking colours: however, at preſent I ſee no reaſon why the ſub-

ject

ject ſhould ſink into oblivion, becauſe people more capable than myſelf have not entered upon it.

The Beauties of building do not conſiſt in the profuſeneſs of ornaments, the ſtrength of its different members, nor in the well executed parts of the different artificers works in general; but in the perſpicuous compoſition and harmony which with freedom one part bears to another, touched again with ſuch an excellency of proportion that every particular may ſeem to have a natural prime exiſtence of its own, ſuitable to the purpoſe, and yet in every reſpect adequate to the whole deſign; no latent or ſtudied maxims in peculiar faſhions, which deviate from the delicacy of the arrangement, can be entitle to a place in the compoſition of Beauty; ſuch are crude and puerile notions, whereas Beauty is the dexterous reſult of ſound judgment, and cannot in any wiſe be attained but by propriety. In order therefore to acquire a knowledge of this, the learner muſt firſt ſtudy the principles of building in general, the intent and ſituation, for what the edifice is to be adapted, its appurtenances and relative conſequences; and from thence endeavour to make the deſign anſwerable to the purpoſe, the particular works anſwerable to the deſign; and to let it conſiſt of ſuch well-choſen and lively embelliſhments as may add dignity and elegance to the ſtructure, ſuch as ſhall be in

in no wiſe foreign either to the place or intent.

It is greatly to be lamented that we ſee architects capable of deſigning what they pleaſe, or of erecting any thing to any purpoſe, and yet neglect this powerful charm, not ſo much through a want of the knowledge of its peculiar graces, but through an idle notion of following the dictates of timeſerving noveliſts: whereas if they would endeavour to follow the ſenſible dictates of their own reaſon, I make no doubt but we ſhould daily ſee more ſtriking proofs of their genius.

The fertile invention of an *Adam* can with propriety form what compoſitions he pleaſes: being in full poſſeſſion of taſte, he can make her dictates ſubſervient to his will; but I would caution inferior geniuſes, how they ſtep forth in the ſame dangerous path. Though there are (it muſt be allowed) very graceful attractions, and ſeemingly a very extenſive field here to roam in; yet the leaſt impediment muſt of neceſſity diſconcert their ideas, and plunge them into ſuch a labyrinth of confuſion, as will require ſome difficulty to eſcape without inevitably deſtroying the point in queſtion.

LECTURE XIII.

OF ARCHITECTURE.

ARCHITECTURE is one of the noblest of the liberal sciences, and deduces its origin from the time our first parents made an arbour to cover themselves against the inclemency of the weather: its first principle is geometry, a most excellent knowledge, as being the basis and foundation of all building. The maxims of geometry are both speculative and practical; from the first are demonstrated the properties of lines and angles; the latter teaches how to apply them to practice in architecture, fortification, &c.

The word Architecture is now understood in a more improved sense, and imports the construction of an edifice, either for private or publick use, according to some or all the five established orders invented by the ancients, following their proportions, enrichments, and ornaments, in a manner every way suitable to the size, strength, and beauty of the work intended, and as they are laid down by the most celebrated artists, and all of them called from their places of invention, which are as follow, viz. Tuscan, Dorick, Ionick, Corinthian, and Composite.

As there are not many noble treatises of architecture extant, I shall not take up much of my readers time with a theoretical definition

nition of the five orders; nor can I, according to my preſent plan, allow it, my operation of practice being ſo extenſive: therefore I ſhall only mention ſome few particulars relative to their riſe and conſequence, and proceed with my remarks of meaſuring, and other things of uſe for the aſſiſtance of thoſe for whoſe uſe this plan is propoſed, who in general are the working part of mankind.

Of the TUSCAN *Order*.

The Tuſcan order had its original in *Tuſcany*, a province of *Italy*, from whence the name is derived. It is much the plaineſt of all the orders: notwithſtanding, it hath great beauties if we conſider its uſe, and apply it where ſtrength is required. The juſt proportions and well-deſigned form of this order (wherever it is well appropriated) are both ſtriking and elegant, though ſimple; yet its ſignificancy may juſtly vie with the richeſt. The column with its baſe and capital ſhould be in length 7 diameters, the entablature 2. The Tuſcan column ſhould diminiſh one fourth of its diameter. The proper manner of placing this order, is at the bottom of the ſtructure; in which caſe it hath its real appearance, being of ſufficient ſtrength to ſupport the reſt of the orders above, or as many as may be thought conſiſtent.

Of the DORICK *Order.*

The Dorick order took its riſe from the *Dorians*, a *Grecian* people who dwelt in *Aſia*. This order, though little inferior in ſtrength to the Tuſcan, is nevertheleſs frequently uſed without its pedeſtal, in places where little elſe but beauty is required. Though it may be ſaid to have certain deficiencies in ſome of its component parts, yet upon the whole it is a maſterly compoſition.

Many commentators have differed from *Palladio* in a few particulars of the entablature belonging to this order; and if any thing they have come near that great maſter, we may allow ſome of them a ſhadow of merit here.

The Dorick entablature is a well-deſigned and noble piece of architecture; the ornaments and enrichment of bells and triglyphs, &c. in the frieze and planceer of its cornice are ſo maſterly, that they are incapable of additions. Many in the execution of this order have, inſtead of the triglyphs, ſubſtituted flutes, &c. but to very little effect. If thoſe that took theſe liberties had but known the ineſtimable treaſure of the beauties they had been rifling, they would have been content to follow the dictates of the greateſt judges that ever lived, rather than offend the eyes of every man of judgment and ſpeculation with their own paltry variations.

The Dorick order may be applied to the first story of a building, and is generally used so without the least deficiency. Its column, base, and capital may be made 8 diameters high, and diminish one sixth. It is the best order that can be made use of for the fronts of doors, &c. on account of its large projections, which answer every purpose in preventing the weather from affecting those who have occasion to wait at the doors of houses till they can gain admission; a circumstance which should be maturely considered, because the rain is usually more rapid and violent under the eaves of the edifice, owing to what is discharged from the cornice of the house, set-offs, &c.

Of the Ionick *Order.*

The Ionick order was first invented in *Ionia*, a province in *Asia*. Of this beautiful order was built one of the seven wonders of the world, viz. the noble temple of *Ephesus*, dedicated to *Diana*, wherein were 127 columns, all of so many entire stones. The height of this column, base, and capital is 9 diameters, and diminishes one sixth of the width.

The greatest beauty in this distinguishing order of architecture lies in the slenderness of the shaft of the column, and in rendered still more so by the flutings, which is this order have a pleasing effect; the volutes or rams-horns of the capitals are also excellent additions,

additions, as well as all its mouldings, enrichments, &c. which are little inferior to the Corinthian. This order is in its proper ſtate when placed upon the Doric, and the Corinthian upon this.

Of the CORINTHIAN *Order.*

The Corinthian order is the moſt noble and beautiful of all the orders, and took its original from the city of *Corinth*. This rich piece of architecture may juſtly be called perfect, as being beyond the power of art or genius to improve. Its merit conſiſts not only in the diſtinguiſhing order or arrangement of any peculiar part, but in the harmony of the whole; being ſo well adapted, ſo proportionably juſt, that art and nature combined muſt allow, in this grand compoſition, their meridian almoſt rivalled. One of the chief ornaments in this order is the capital of the column, whoſe height is equal to the diameter of the column below, and compoſed of leaves to the number of 16; between which riſe ſmall ſtems or ſtalks, that form the volutes, and ſupport the abacus, which may be underſtood as the top moulding or covering of every capital.

The Corinthian column with baſe and capital ſhould be 10 diameters high; and when fluted conſiſt of 24, and be made half as deep as broad. The fillets or ſpaces between muſt be one third of the width of the ſtute: and the bell or face under the leaves muſt ſtand perpendicular under the bottom of the

flutes; in which case solid is under solid. The Corinthian pedestal is one fourth of the height of the column, and the entablature one fifth, which consists of architrave, frieze, and cornice.

Of the Composite *Order.*

This order received its rise from the ancient *Romans*, who first invented it, and has its name merely because it is a mixture, or composed of the Ionick and Corinthian orders, or rather of the whole five.

By some it is reckoned the most regular and beautiful of all the orders: but those who are pleased to give it this appellation, do it either through want of judgment, or, not enquiring into the merits of it, suppose that to be best which is composed of the beauties of the whole. It is certain, that the parts of the Composite order are in a capital light in their respective places; but as they now stand are rather puerile and unconnected, and may be stiled an immature compound of consistencies, void of grace, and barren of invention. Why I call them consistencies, I would have my readers understand: The members which form this order are in their nature beautiful; but being applied or stretched beyond their real effect, become ludicrous, wanting form and propriety. I cannot say this order reflects any peculiar merit on the composers, though it is much better than any thing we see invented in our days.

The

The composite order is usually placed upon the Corinthian: but in that situation it must appear to disadvantage, having no properties of its own to recommend it; and those which it doth consist of are so feebly adapted, that it is the height of imprudence to place this order in any state, unless quite abstracted from the rest; nor can it with the least propriety be used on the outside of a building. Its column with base and capital is ten diameters, and should not, if placed upon the Corinthian, diminish more than one sixth of the diameter below.

It would be well to consider the nature of the orders in general, especially with regard to the propriety of their ornaments, when appropriated to the outside of a building. In my opinion, the chief elegance of a structure consists in its plainness, and it would add much to the dignity of every building where the orders are introduced, if no ornaments were applied but where their want might be thought a visible defect. For my own part I cannot think, that either carvings or fluting of columns have the least share of beauty when placed on the exterior part of a building. Ornaments of this sort to me appear rather studied decorations than natural effects.

I am very conscious that some of the greatest judges of the age would strenuously contradict this opinion; but I am full as confident that thousands will think with me. When they have leisure to give this great par-

ticular a thought, and judge from appearances, I would only ask any person of reasonable abilities, whether the vast profusion of ornaments lavished on some of the publick buildings (which have lately made such a noise in the world) be any addition to them? whether they are not more gaudy than grand, and whether they do not lose their natural magnificence by these superfluous introductions?

I am sorry that it should fall in with my design to descant upon the works of any great author; but the rest would have their faults pointed out, because it is in their power entirely to new mould the system of business, and lead the unthinking people from the evidence of their own understanding.

LECTURE XIV.

OF MEASURING.

MEASURING is the art of finding the contents of superficies and solids; and is that part of geometry, or rather practical mathematicks, which elucidates some determinate quantity, appointed to be a standard or common gauge for things to be denominated by; as to their length, breadth, and thickness: as a rod is a common measure for brick-work; a square yard, or foot, for defining the contents of carpenters, joiners, plasterers work, &c. which once understood, and where to be properly appropriated in the different

different artificers works, according to their nature and custom, needs no more than common arithmetick to perform, though at present deemed a mystery of such high estimation as to form a trade of the first consequence; notwithstanding there is little more in it than what any common school-master is capable of; unless it be required that a measurer should stipulate the prices of the different works he runs over; in which case he must be well acquainted with the several branches of building, as well as the quality and quantity of materials; a matter which many of our modern surveyors are totally ignorant of, and which reflects great indignity on their profession; as being one of the principal efforts to the science of surveying, and of much more importance than fine drawings, which are too frequently the main object of the gentlemen of this art. For if they are but tolerable adepts in this particular, they think but little of any thing more; for with regard to the prices and value of work, they say they can easily acquire them by getting the estimates of different workmen for the drawings they have to execute; out of which with little trouble they shall be able to fix different ones of their own. But how little is a person of this sort to be depended on, either with regard to the construction, or surveying of an edifice of consequence? and yet to the disgrace of architecture, we have men who stile themselves

architects

architects and ſurveyors, that are hardly capable of building a warehouſe, without numberleſs errors; and at the ſame time if a workman of ſound judgement, endowed with the requiſites of taſte and long experience, were but to propoſe his opinion, though never ſo eſſential to the point, it would be at the hazard of his place, for even thinking to dictate to the genius of a man of ſpeculation, and one who is capable of making a drawing handſome enough for a print-ſhop.

It is greatly to be lamented that there is not a proper ſtandard or certain pitch of perfection in this as well as many other learned profeſſions, for a man to arrive at before he can be pronounced either an architect or ſurveyor, the one much inferior to the other; and that thoſe who have not merit enough to the former might be deemed the latter, and thoſe who have not pretenſions ſufficient for either might be termed meaſurers. A gentleman would then know whom he has to apply to for maſterly compoſitions and undertakings; there would be a viſible difference in their profeſſions, though at preſent they are conſidered as ſynonimous. If there were ſuch a reſtriction upon the profeſſors of architecture, and none were allowed the name but ſuch as had a thorough knowledge of the liberal ſciences, as well as a proper depth of reaſoning on their effects, how few (in compariſon to the numbers who aſſume the appellation) would be deemed capable

pable of taking their degrees; though we have many fit to take the chair upon the occasion, as well as others to be censors.

But I beg my readers pardon for this digression, and will instantly proceed with my remarks upon measuring; a matter of some moment to every workman who may hope to be a master.

The principal thing in measuring (as I before observed) is the nature and custom of it; that is, what is allowed as work to a standard price allotted, what is work and half, double work, &c. Of these there is the greatest variety in joiners work, which hath almost as many variations as different sorts of work.

When a person is well apprized of the customs of the different instruments and modes of dimensions, he must consider the most advantageous way of setting down his mensurations, so as to avoid confusion and perplexity. In his book of dimensions he must be careful to separate with difference the various sorts and manners of execution with which the work is done, as well as the different apartments to which they belong, and every branch distinctly. But in order to furnish my reader with as plain and concise a method as possible, it may not be amiss to give a sketch of a book of measurements, and of all the common incidents that can occur in a building.

And first, of brick-work, the rule of measuring which is by the rod of sixteen feet

feet and an half square, to one brick and half thick, which is the standard of all common brick work.

The usual way of measuring a building is to begin first at the foundation, from thence at the first story, and so on to the top, taking every story separate, with their additions, deductions, &c.

Example of Foundations.

Take the length of the front and one end, and double it for the length; and observe, if you take the length of the front from out to out, you must take the ends from the insides of the front and back walls; next take the height of the foundation, and write them down in the following order, to be squared at leisure.

Foundation.

Ft.	In.		
146	0	Length.	$4\frac{1}{2}$ bricks.
6	6	Height.	

As all foundations should diminish upwards, in order to come at the real thickness of the wall, count the number of bricks at the top, the same at the bottom, and add them together, and take half the thickness.

EXAMPLE.

If the foundation at the bottom be $5\frac{1}{2}$ bricks thick, at the top $3\frac{1}{2}$; those added together (as in the margin) make 9, the half of which is $4\frac{1}{2}$, the real thickness of the wall, which is set down as above.

5	$0\frac{1}{2}$
3	$0\frac{1}{2}$
9	0
4	$0\frac{1}{2}$ bricks.

Next take all the party-walls, burrs for chimnies.

Foundations of party-walls.

Feet.

26 Length.
6 Height. } 3 bricks—4 times.

The above dimensions are the supposed length and height of one party-wall 3 bricks thick; but for brevity I say 4 times, there being four cross foundations of the same dimensions. In like manner take every thing within ground; then take the basement story, consider the set-offs both on the fronts and ends, and from the first length deduct or take the dimensions over again.

EXAMPLE.

The first is the length and height of the basement story; next deduct the win-

Basement story.

Feet.

145 Length.
10 Height. } 4 bricks.

dows

dows and doors in the front. In taking the deductions of windows, I think it the most familiar method to calculate the whole opening from the floor to the top, and after add the pieces under the sash-frame, because of the different thickness.—See the example.

Next take the breast of chimnies as they project into the rooms, which the reader will observe are all to be measured as solid, on account of the trouble, and pargetting the inside. The method is to take the height to the turning of the trimmer, and the width of the breast, and afterwards to count the number of bricks it is in thickness; then deduct the opening.

Deductions of windows.

Ft.	In.	
9	5	4 bricks—6 times.
3	4	

To add under windows.

3	4	1 brick—6 times.
2	6	

Deduct front door.

7	0	4 bricks.
3	11	

Deduct windows back front.

8	10	4 bricks—3 times.
3	4	

To add under windows as before.

3	4
4	5

Kitchen chimney to add.

9	0	Height.	3 bricks.
6	6	Width.	

The opening of chimney to deduct.

4	10	3 bricks.
4	6	

And

And in the ſame manner proceed with every deduction of inner rooms in every ſtory, and the addition of chimnies, &c.

In taking the dimenſions of vaults, firſt meaſure the abutments to the ſpringing of the arch, and afterwards bend your rods round the arch for the width. The length of the place is undoubtedly the length. If the vault be grounded, after you have meaſured the ſuperficial contents, you muſt alſo meaſure the run or angles of the groin, which are always conſidered at leaſt as ſuperficial feet extra, and ſometimes an additional price allowed for them, which ſhall be hereafter noticed in the practice of brick-work. There is one thing in the dimenſions of end-walls to vaults which ought to be mentioned, that is, the riſing the crown of the arch; to which part the height of the end walls muſt be taken. No allowance either for ſtuff or labour muſt be made for the want of the declivity of the arch, on account of the additional trouble of cutting and waſte of bricks. The ſame thing is alſo to be obſerved with reſpect to arches over doors; no deduction muſt be made for them, becauſe of the trouble. The dimenſions alſo for the height of ſuch deductions are not to be taken higher than the ſpringing of the arch.

As the meaſuring of chimnies in angles may be attended with, or ſeem a difficulty to thoſe who are unacquainted with the method, I propoſe the following rule for their practice.

Multiply half the breadth of the front of breast by the height, and that product by the number of half bricks contained in the half breast, (as to width) and divide the last product by 3, the contents will then be the contents in feet: out of which the opening is to be deducted, as in square chimnies. See the example.

Suppose a chimney that stands in an angle to be 6 feet 6 in. in breadth, the height of the story 10 feet, I place them as in the margin, and multiply half the breast, which is 3 ft. 3 inches, and afterwards multiply that product by the number of half bricks the half breast contains, which we may suppose to be 8; then I divide the last product by 3, the number of half bricks in the standard of brick-measurement, which gives the above dimension 86 feet of reduced brick-work; after this you are to deduct the opening, as in other chimnies. By the above example all other angle chimnies may be measured.

	Ft.	In.		
	10	0		
		3	3	
	2	6	0	
	30	0		
	32	6	0	
			8	
3	260	6	0	86
	24			
	20			
	18			
	2			

By the foregoing method all sorts of common brick-work are measured; in every story the

the ſame, according to the thickneſs, re-bates, and deductions of the ſeveral walls, keeping every ſtory ſeparate till you come to the top of the edifice; eſtimating the chimnies as ſolid all the way up; the parapet walls according to their thickneſs and dimenſions; and doing the ſame by gable-ends and pediments. Theſe laſt mentioned articles may want ſome explanation with regard to the manner of meaſurement.

RULE.

Multiply the length of the baſe by half the perpendicular, or the perpendicular by half the baſe, the product will be the ſuperficial content. For inſtance: Suppoſe a gable-end, the baſe of which is 18 feet, the perpendicular or height 13 feet 6 inches, I ſet down 18 feet, the baſe, and multiply by 6 feet 9 inches, the half of the perpendicular, the product is 121 feet 6 inches, the ſuperficial content; then count the number of half bricks it contains in thickneſs, and proceed in every reſpect as in other work. I think it needleſs to ſay more concerning the meaſurement of common brick-work.

Ft.	In.	
18	0	
	6	9
13	6	0
108	0	
121	6	0

The manner of reducing walls to the ſtandard thickneſs, is particularly mentioned in the practice of brick-work. The meaſuring gauged work, ſuch as arches, facios, cornices, &c.

&c. is as follows; and all valued by the superficial foot.

The most familiar way of measuring a skew-backed arch, is to take the length of the top and bottom, and add them together for the length, the height of the arch for the breadth. Circular arches must be measured as is set forth in my mensuration of circles, &c. Cornices of brick are measured as to length, and the mouldings girt with a string for the breadth. Facios are measured superficial.

In taking the dimensions of brick-work it is usual to take and give within the compass of an inch. For instance: If your length or width runs better than half an inch, you take the full inch; if under half an inch, nothing. For example:

If a wall be 74 feet 6 inches, and rather above half an inch more, you call it 74 feet 7 inches; but if rather less than the half inch, it will only be allowed as 74 feet 6 inches. In measuring of arches, &c. it is necessary to measure to the part of an inch.

The next work done by bricklayers is tiling, which is measured by the square of ten feet each way, and multiplied into itself contains 100 superficial feet. There is no difficulty in taking the dimensions of, or in measuring tiling; only take the length of the roof between the gable-ends, and from the ridge to the eaves for the width; multiply the one into the other, and divide the product

duct by 100, or cut off one or two figures to the left hand for squares. For example: If the number of feet contained be hundreds, cut off one figure for squares, the rest are feet. If the number of feet be thousands, then cut off two figures to the left for squares (as in the margin.

Sq.	Ft.
4,23	
13,02	

Suppose the side of a house contained 423 feet, then cut off the 4, which is 4 square; there remains then 23 feet. The same is to be observed of thousands of feet, as in the margin.

The reader is to take notice, that deductions must be made for chimnies, and also in plain tiling. If there be a double course at the eaves, 4 inches more must be added to the width. With regard to hips and vallies, dormers or windows, where valley-tiles are used, the run of the angles, vallies, and hips must be taken: and for every foot in length a foot superficial must be added to the measurement, on account of the trouble that attends them in practice.

If your roofs be hipped, take the length at the bottom of the sides, and not measure the ends; for it is a maxim, that the two ends make out the want of the sides.

The last of bricklayers work to be measured is paving; which is done by the yard, and contains 9 superficial feet. In this sort of measurement there is no difficulty; only take

the length and breadth of the place in feet, and multiply them together, then divide the product by 9, the quotient will be the content in yards, and the remains feet: afterward make the neceſſary deductions, and your work is complete.

How to meaſure Carpenters Work.

For Carpenters work two modes of meaſurement are in uſe; the one by the ſquare, the other by the cubical foot. The former is now almoſt obſolete, except with reſpect to labour. However, for the benefit of the learner, I ſhall treat of both the methods, and leave the ſtudent to adopt that which pleaſes him beſt—or which is moſt approved of by his employer: For as it will not require much application, he may eaſily make himſelf acquainted with both.

With reſpect to the merits of the two different manners of meaſuring carpenters work, I will not take upon me to decide, (as they are both replete with errors,) but approve of that moſt which comes neareſt to the truth, or ſeems moſt equitable. In meaſuring by the ſquare for the real value to a ſtandard price, you muſt in many caſes err, becauſe in large buildings the ſcantlings will require to be proportionably augmented, and without a price, according to them, the maſter will be viſibly injured. Again, on the other hand, if the buildings run leſs, the common prices by the ſquare will be too exorbitant; and the

ſame

ſame with reſpect to cubical meaſure. If a maſter have the ſame price for buildings with large ſcantlings as ſmall ones, he muſt be extravagantly paid for the former; the reaſon is, that ſmall buildings take above twice the expence to ſaw the timber.

The method I practice is to value all carpenters work by the cubical foot, according to the ſcantlings and the quality of the timber, and afterwards ſettle a proper price for the labour according to the nature of the work. This I have ever found the moſt feaſible mode, and the neareſt to a certainty of any thing I can adopt for the purpoſe.

The method of meaſuring carpenters work by the cubical foot is as follows: Suppoſing it a floor, firſt take the dimenſions of the plates, ſuch as the length, breadth, and thickneſs; next the girders (if any); then the joiſts, whether binding ditto or common. In meaſuring of joiſts, having got the length of one, take the different ſcantlings, and if they vary much, take a medium for your dimenſion to the length of one, afterwards count the number of joiſts in the tier which will give the quantity of timber in that ſpace: proceed then in like manner with the reſt.

EXAMPLE.

Suppoſe a floor to be 24 feet by 15 feet;

Plates.

	Feet.		
Twice	25		Length.
	6	: $3\frac{1}{2}$	Scantling.
Twice	16		Length.
	6	: $3\frac{1}{2}$	Scantling.

Deduct for the chimney 5 feet in length.

Firſt take the length of the plates with what goes into the wall, which makes 25 feet, the ſcantling 6 inches by $3\frac{1}{2}$, the length of the end 16 feet by 6 : $3\frac{1}{2}$ twice; afterward deduct 5 feet in length to the ſame ſcantling for what is omitted for the chimney. This is a juſt way of taking and ſetting down dimenſions to be ſquared at leiſure, but rather too tedious. In order therefore to avoid prolixity in this ſort of meaſurement, I would adviſe my pupil to the following method of ſetting down the different lengths together upon the waſte part of his book, afterwards adding them up for one length and noting them in the ſetting down in the following manner, viz. having ſet down the different lengths, as in the margin, and after adding them together and taking the deduction, the remainder will be 77 feet of plates in length, the ſcantling 6 inches by $3\frac{1}{2}$, which write down as under.

	25
	25
	16
	16
	82
Deduct	5
	77

Plates

Plates in dining-room.

Ft.	
77	Length.
6 by $3\frac{1}{2}$	Scantling.

Girder to ditto.

Ft.	In.	
16	3	
	$11\frac{1}{2}$ by $9\frac{1}{2}$	Scantling.

Common joists to ditto in the half tier.

Ft.	
182 : 6	Length.
9 by $3\frac{1}{2}$	Scantling.

Next take the girder, which we will say is (with the allowance of 9 inches at each end into the wall) 25 feet 3 inches scantling, $11\frac{1}{2}$ inches by $9\frac{1}{2}$; place this as in the margin.

The common joists, allowing 4 inches tenon into the girder, and 4 inches into the wall, we will say are in length 12 feet 2 inches, the scantling 9 inches by 3; the length of one being then 12 feet 2 inches, and the number of joists in the tier 15, we are next to multiply them together for one length, which is 180 feet 6 inches, placing them as before. If the other tier run to the same dimensions, you may write down twice. Observe also, in case of trimmers of fire-places, if the length of the trimmer be not sufficient to make out for the want of the joists cut off in the said fire-place, the proper deductions must be made, and the trimmer added.

15	
12	2
2	6
180	
182	6

In

In the above manner proceed to take the timbers in roofs, partitions, lintels, bond timbers, discharging pieces, wood bricks, door cases, bressumers, story posts, bridgings, planking piles, leading piles, carriages to stairs, turning pieces to chimnies, &c. It may not be amiss here to observe, that in taking the waste of timbers, half measurement only is to be taken for stuff returned, such as bonds through windows, which are cut off, turning pieces to chimnies, shoring needles, &c. and in some cases of centring as to trimmers, &c. Therefore in the taking the dimensions of these, it will be necessary to note them accordingly.

Thus much will serve to instruct the learner relative to the mode of measuring carpenters work by the cubical foot; the method of squaring dimensions shall be shewn hereafter: also the proper price for work of this sort, both with and without labour, will be treated of in the value of carpenters work. For measuring by the square observe the following methods.

And first, of the carcase of a framed building; the method of measuring which is to take the length of one side, and one end, and double it for the length, and that sum multiplied by the height taken from the bottom of the cell to the upper side of the raising plate, the product will be the contents in feet, which being divided by 100, or cut off as before observed, you will then have the real

real number of ſquares the houſe contains, which is the rule of meaſurement for all timber-buildings, roofs, naked floors, &c.

EXAMPLE.

Suppoſe a houſe 50 feet long, 25 feet high, and 20 feet wide, how many ſquares are contained?

Firſt add 20, the width of one end, to 50, the length; that multiplied by 2, gives 140, the length; which being multiplied by 25, the height, the product is 3500 feet; this being cut off as before obſerved, the real contents are 35 ſquares of framing. Note that to a houſe of theſe dimenſions, in meaſuring the carcaſes of houſes no deductions are to be made for windows, doors, &c. the extra labour to ſuch being more than adequate to the value of the openings.

50
20
70
2
140
25
700
0
35,00

To meaſure Roofing.

The principles of this ſort of work meaſured by the ſquare, may be reduced to the following rule, whether true pitch, or the ends gable or not, viz. Multiply the building's length by the length of the rafter, and twice that product will be the contents in feet; then cut off as before obſerved, and the work is done. See the operation:

If

If the rafters be what is called true pitch, viz. three-fourths of the width of the building, then to the above building of 20 feet wide the rafters will be 15 feet, which being multiplied into 50, the length, the product is 750 feet; this again being multiplied by 2, gives 1500 feet, the contents, which cut off as before, and you will find 15 square in the roof to the above dimensions.

50
15
——
250
50
——
750
2
——
15,00

To measure a gable-end in carpenters work is the same as in brick-work, viz. multiply the width by half the perpendicular, the product will be the superficial contents in feet. Note, the same rule will serve for measuring the hip-ends of roofs, only making the length of the rafter as the perpendicular.

Rafters, feet and eaves boards, are measured by the foot lineal; gutters and bearers by the superficial foot.

How to measure naked Floors by the Square.

The length and breadth are to be taken from the outside of the plates: if none be made use of, as in some countries, they are then to be omitted, and the joists laid in the naked wall; in this case you must allow 9 inches, or else measure the full extent of the joists, and from thence compute the squares contained by the above examples; the same of

of cieling joists, partitions, battering the walls, &c. allowing the deductions of doors, windows, &c. if agreed upon, otherwise not.

How to measure Centres.

Centres are measured by the square; the dimensions taken from the sweep of the arch, and the length of the place.

Small centres to doors and apertures, &c. are measured by the foot superficial.

Carriages to stairs also are measured by the superficial foot; the leading pieces or strings by the foot solid; trussing of girdles by the foot lineal; door-cases of timber by the cube foot; lintels, bond timber, discharging-pieces, &c. all by the cube foot; weather boarding by the square; and trunks by the foot. The several prices and real value are mentioned in the practice of carpenters work.

To measure Joiners Work.

The measurement of Joiners work is attended with more difficulty than all other artificers work besides, merely owing to its extention, or great variety of practice; at the same time it is the least understood of any, chiefly through a want of attention, or judicious enquiries into the length or consequence of time which every piece of work takes in the execution. Could this be once ascertained, the whole might as easily be reduced to a system as any other work.

In

In defining the real principles and properties of this branch of business, I shall be as particular as the subject may require, both with respect to time and the mode of measurement, in order to render the design as easy and useful as possible, both to professors of building, and others who may be desirous of making themselves fully acquainted with the practical requisites, as well as the manner of measuring an edifice.

The work done by joiners in a building may be reckoned or settled in the following short terms, to be every thing that is worked with a plane; therefore will need no farther explanation than what may be assigned in the different works as they occur. And first, of frontispieces.

How to measure Frontispieces.

Frontispieces are measured and valued by the superficial foot, every part of them being measured separately, and all bearing a different price. But the best way of giving the learner an idea of this sort of workmanship will be to set down the different measurements by supposition, as before observed of brick-work.

First take the dimensions of the grounds at twice, viz. first to the height of the door

Of the Grounds and Jambs,

	Ft.	In.		
	7	0	Length	twice.
By	1	4	Width	

door for the two jambs, and from thence to the top of the pediment, which muſt be taken to the extent of the height and width, making no deductions for the fan-light, nor what is cut off at the top, to form the pediment, on account of the trouble and labour that attend them. Firſt I take the ſuppoſed length and width of one front, ſtile, or jamb, and ſet it down as obſerved next the ground, above or under the pediment; then I take the columns, ſhaft, baſe, and cap, for the length, and the girt round the column for the width; the

Grounds from the top of the door and the pediment.

Ft.	In.		
5	8	Width.	
4	0	Height.	

Columns with baſe and cap.

7	3	Length	twice.
1	9	Girt	

Subplinth.

2	9	Length	twice.
	4	Breadth	

Trunks or grounds for the architrave, frieze, &c.

1	6	Length	twice.
2	2	Girt	

Architrave.

2	6	Length	twice.
	6½	Breadth	

Level cornice to the top of the facio.

3	0	Length	twice.
	10	Girt	

Scima Recta level that mitres to the pediment.

1	3	Length
	2½	Girt.

ſub-

ſubplinth, length and breadth; the trunks that ſtand perpendicular above the ſhaft of the column, for the architrave, frieze, and cornice, to reſt upon the next architrave. Level cornice; the ſcima recta, which mitres to the raking-mould of the pediment; with the length of the cornice on both ſides of the pediment; level blocks or mutules, raking ditto; impoſt; jamb-linings, bead, and fluſh; circular ſopheat ditto, and door-caſe; all meaſured cubical. The ovolo double meaſure. For fan-light, when meaſured by the foot, take the width of

Ft.	In.		
Length of Cornice on both ſides of the pediment.			
5	9	Length.	
1	2	Girt.	
Mutules, or Blocks level.			
6			
Ditto raking.			
5			
Impoſt round the Jamb-linings.			
8	0	Length.	
	6	Girt.	
Jamb-linings, bead, and fluſh.			
7	0	Length	twice.
1	8	Breadth	twice.
Circular ſopheat, bead, and fluſh.			
5	0	Length	Double meaſure.
1	8	Breadth	Double meaſure.
Door-caſe.			
7	4	Length	Scantling 4 by 3.
4	0	Width	Scantling 4 by 3.
Ovolo round the circular head.			
5	0	Length	Double meaſure.
	$2\frac{1}{2}$	Girt.	Double meaſure.

the

the door and the height of the crown. Obſerve alſo in girting the impoſt, that you take from the grounds, and extend the line all round the face of the moulding, and likewiſe the ſame with reſpect to the ovolo.

Fan-light.		
Ft.	In.	
3	6	Width.
1	9	Height.

Door, bead, and fluſh.	
7	0
3	6

Cover boards and bearers.		
6	0	Length.
1	6	Breadth.

Though the above dimenſions are contingently ſet down without propriety to their reſpective proportions, yet the manner will ſerve to inſtruct the learner the ſame: after the meaſurements are thus taken, the mode of ſquaring them will become familiar; the different prices to all the dimenſions are conſidered in the practice of frontiſpieces.

To meaſure Floors.

Floors are meaſured by the ſquare; the dimenſions of which are the full extent of the rooms both ways. Obſerve in meaſuring floors, that you make no deduction for the ſlab at the fire-place; the reaſon is, that the putting round the border is always conſidered as equal to that part of the floor being laid out. What part of the floors is laid into the windows, cloſets, &c. muſt be added.

How

How to measure Dado.

Dado is measured by the yard; the dimensions of which are thus taken, viz. For the breadth, take from the floor to the underside of the capping; the length is the round of the room, allowing an inch more at every angle; the length and breadth being multiplied together, give the contents in feet; after which divide the product by 9, and the quotient will be the number of yards. Observe to deduct chimnies and doors.

In measuring dado for labour to task-masters, it is usual to measure from the floor to the top of the capping, and only girt the surbase mouldings to the front of the dado. This mode of measurement was first invented as an abridgement to the price of mouldings, being matters that afford more profit to the journeyman than any work in the business: it is however a method that cannot be attested, notwithstanding custom hath now made it almost familiar to us.

The reason the dimensions are thus taken for the width of dado, is, that it is customary to consider the skirting at the same price; and as the dado does or should go as low as the top of the skirting, there can be no error in such mode of measurement. When dado and skirting are of different prices they must be measured separate.

How to measure Mouldings.

Mouldings are all meaſured lineally or ſuperficially by the foot: when the former, you have nothing more to do than take the length; when the latter, you muſt girt all the face of the mouldings with a ſtring for the breadth, and the round of the room for the length: afterwards deduct doors and chimnies.

Sur-baſe mouldings are always girt over the face and round the capping; the baſe moulding is girted as much as ſeen, and half an inch more allowed than is ſeen for the re-bate which ſtops the ſkirting.

Architraves are taken with a ſtring over the top and down both jambs for the length, and girted round the face and back to the wall for the breadth.

Cornices are meaſured by the foot ſuperficial, and girt as much as is ſeen for their breadth: the round of the room for the length; and ſo of all mouldings worked by hand. All houſe plain mouldings are meaſured by the lineal foot.

Wainſcotting is meaſured by the yard; the height of the room for the breadth, and the girt or round of the room for the length. Obſerve in this to deduct doors and windows.

Torus ſkirting is meaſured by the ſuperficial foot; the breadth of which is got by a ſtring girting the moulding to the floor; the round or extent of the place being taken for

the length. Obſerve, that this ſort of ſkirting to ſtairs is always allowed double meaſure; the ſame alſo of raking, dado mouldings, &c. if ramped, as the hand-rail of the ſtairs.

To meaſure Doors.

Doors have different rules of meaſurement; ſome being taken by the foot, others by the yard. All framed doors are meaſured by the foot; batten and ledged doors by the yard. If they be what is called double doors, that is, framed and moulded on both ſides, they are accounted as ſingle meaſure, and a price ſtipulated accordingly. The dimenſions are the neat height and width.

Doors that are only moulded on one ſide, are called meaſure and half; batten and ledged doors ſingle meaſure. All ſquare framed doors are ſingle meaſure.

How to meaſure Columns.

Columns of the Ionick, Corinthian, or Compoſite orders are all taken ſeparately from their baſes and caps; firſt, the ſhaft, then the baſe and the caps likewiſe, being all of different prices.

In taking Corinthian, Compoſite, or Ionick capitals, the method is to girt round the abacus for the width, and the length of the capitals from the neck for the height: ſome take only the girt round the abacus, conſidering them

them as so many feet without any height; others estimate them per piece.

Also in measuring fluted columns, I first take the superficies, and afterwards the labour for the fluting, at per foot lineal.

Door-cases and jamb-linings are measured and valued by the superficial foot. The length of the two jambs and the width of the opening is the length. For the width of the lining girt down the rabbit for the breadth, single measure.

How to measure Window-Shutters.

Window-shutters and back-linings are all measured by the foot; the front shutters as measure and half. If they be framed only on one side, the back-flaps and back-linings are to be deemed single measure, whether framed, flush, or square.

Backs, elbows, and sopheats, are by the foot single measure.

Grounds to windows by the foot superficial.

All other grounds in general by the foot run.

To measure Sashes and Frames.

Sashes are measured and estimated by the superficial foot; the dimensions thus taken, viz. the two heights of sashes are added for the length; and the width of the frame for the breadth. Sometimes the sashes and frames are valued together; when so, the

exterior parts of the ſaſh-frame are the bounds of dimenſions. Sometimes ſaſh-frames are done per piece. All circular headed ſaſhes are allowed only double meaſure. In ſome counties they have a method of girting all the bars of ſaſhes both ways; but this is obſolete, and ought to be aboliſhed every where.

How to meaſure Chimney-pieces.

Chimney-pieces of wood are meaſured by the foot ſuperficial and lineal, according as they be finiſhed. Firſt the grounds per foot ſuperficial. If the chimney-piece have no ornaments about it, the architrave, frieze, and cornice may be taken as other mouldings, in the manner of the former obſervations on frontiſpieces. If theſe be terms at the ſides and ornaments, theſe muſt be valued ſeparately. So likewiſe of ornaments in the frieze, flutings, frets, &c. in the cornice; which are per foot run, and a price ſet according to their value. Truſſes and terms are frequently done at per piece.

How to meaſure Stairs.

Stairs are meaſured and valued by the foot: the dimenſions taken by a line bended or girted down; the riſer and tread over the noſings, from top to bottom for the length; the breadth is the width or length of the ſtep. Common ſtairs are ſometimes done at ſo much per ſtory.

Hand-

Hand-rails to ſtairs are ſometimes meaſured by the foot ſuperficial, ſometimes by the foot lineal. When the former, the rail is girted round for the breadth, and the ſtraight part of the rail for the length. With reſpect to ramps, twiſts, ſcrolls, &c. they muſt be taken ſeparate, becauſe they are always double meaſure. The twiſts and ſcrolls three times; the baniſters and newels at per foot run, the ſtrings per foot ſuperficial, girted as other architraves; brackets at per piece.

Sometimes hand-rails to ſtairs are valued with the brackets, ſtrings, and baniſters, by the ſuperficial foot, and the dimenſions taken in the following manner: For the breadth take a ſtring, and girt from the top or middle of the rail down the baniſters, and over the ſtring for the width; the length of the rail from top to bottom is the length. But for the particulars of ſtairs in every reſpect, muſt turn to the practice of them.

The reader muſt obſerve, in taking the different dimenſions, to be particularly careful in his book, to keep every work ſeparate.

The beſt method of meaſuring joiners work through a whole houſe, is to keep a length or leaf for all ſorts of work of one price, and only make obſervations on the different ſtories.

Suppoſe the following to be a ſketch of leaves.

Dado ground-floor.	Mouldings to ditto. Baſe and impoſt.	Architraves to ditto. Architraves to Windows.
Ft. In. 48 6 L. 2 5 B. } Eaſt parlour	48 6 L. 3 B. Sur-baſe. 48 6 L. 5 B. } Eaſt-front parlour	18 0 0 8 } twice Ditto of doors 17 3 0 8 } twice } Eaſt parlour
36 4 L. 2 5 B. } Weſt parlour	39 4 B. 3 L. 39 4 L. 5 B. } Weſt parlour	Windows. 18 0 8 } twice Ditto doors. 17 3 8 } twice } Weſt parlour
30 3 L. 2 5 B. } Hall	30 3 Baſe 3 30 3 Sur-baſe 5 } Hall	
36 7 L. 2 5 B. } Study	36 7 Baſe 0 3 36 7 Sur-baſe 0 5 } In Study	Window. 18 8 Door. 17 3 8 } Study.

In the above manner it will be requiſite to place the dimenſions, ſo as to avoid perplexity, keeping other leaves for floors, window-ſhutters, &c. and every floor ſeparate; by which means you will avoid an infinite deal of trouble when you come to ſquare the dimenſions.

How to meaſure Plaſterers Work.

Plaſterers work hath in the manner of its meaſurement (in ſome particulars) as much variety

variety as joiners work, especially in ornamented cielings, which require great understanding, as well as extensive practice, to come at a just criterion for the different enrichments, which are all taken and valued by the foot lineal and superficial. Sometimes they are done at a fixed price per cieling; but a man must have great experience to guess at a matter of such consequence by the bare inspection of a drawing; although it is certain we cannot do otherwise than guess at the value of some particulars, such as figures, deities, trophies, &c. which always vary with the subject. However, the first thing to be taken is the plane of the cieling, which is by the yard; next the cornice, frieze, enrichments, &c. which must be girted as joiners work; the round of the room being the length.

Having done this, proceed to take the ornaments upon the cieling, in the following order; first, take all the mouldings lineally, whether carved or plain. If any of the mouldings be cast, they must be noticed: if any of the mouldings are oval, circular, &c. they are to be considered as measure and half. Some take circular and oval mouldings single, allowing a price accordingly. Then take all the sweeps of foliage as superficial. In the following manner take the length and width of the square in which the ornaments are contained, and, according to their value, stipulate the price, as you go on, to every sort of work. To avoid perplexity, if there be any golicchi,

or frets above three inches wide, they muſt be taken ſuperficially, otherwiſe lineally. Ribbons over mouldings are run trophies, and all large conjunctions, taken per foot ſuperficial; figures are uſually valued by the piece; all enriched friezes, feſtoons, &c. by the foot ſuperficial; if friezes be caſt, they are valued in the cornice; belexion mouldings by the foot lineal; large pannels of ſtucco by the foot; all walls and plain cielings by the yard; all circular work is conſidered as meaſure and half, or ſingle, and a price accordingly: Ionicks, Corinthian, and Compoſite caps taken per foot ſuperficial. Obſerve in meaſuring walls to make deductions for windows and chimnies.

To meaſure Glaſiers Work.

Glaſiers works are meaſured by the foot; the dimenſions taken in feet, inches, and parts of a foot: it is requiſite therefore that glaſiers ſhould underſtand decimals; though, for my own part, I ſhould propoſe duodecimals, being quite as correct, and much more familiar and conciſe to learners.

The two following examples will prove what has been advanced on this particular; the one by decimals, the other by duodecimals; and although they both anſwer the intent, I think to learners the duodecimals ought to have the preference.

Suppoſe

Suppose a piece of glass leaded were to be 3 feet 6 inches by one foot 6 inches:

By decimals.	By duodecimals.
Ft. In.	Ft. In.
3 , 50	3 6
1 , 50	1 6
17500	1 9 0
350	3 6
5,2500	5 3

By the former method (by decimals) it appears that the light of glass is 5 feet and 25 parts, being equal to one-fourth of a foot; and by duodecimals 5 feet 3 inches, which is one quarter of a foot. The reader will observe, that in measuring sash-windows there is no occasion to take dimensions of more than one square; that multiplied by the number of squares in a window will give the contents; which once got, requires no more than to add or multiply by the number of windows in the story, or of one size, and that sufficiently resolves the question.

In some counties the glasiers only measure the exterior part of the glass for length and breadth, allowing nothing for the thickness of the bars: but this is an exorbitant way, and ought to be eradicated.

How

How to measure Painters Work.

Painters work is measured by the same rules as joiners, with this difference only, that they do or should measure all edges where the brush goes. But surveyors are not always so particular, and frequently allow no more measure to painters than joiners, except in case of doors, window-shutters, &c. which with painters are always double measure, the same as any thing else is painted on both sides: all wainscot, dado, moulding, doors, shutters, jamb-linings, architraves, &c. are measured by the yard; cornices of all sorts, and single skirting by the foot run; frontispieces, &c. by the foot; sashes, sash-frames, casements, window-lights, &c. are done per piece.

How to measure Mason's Work.

Masons work is all measured by the foot, though with the difference of cubical, superficial, and lineal. First, with respect to the cubical method, which is used for all blocks of stone, marble, &c. and which is in the manner of work always considered as such, when the thickness of the stones exceeds 2 inches; all under this standard are measured as superficial. When stones exceed the solid standard of 2 inches, they are first measured solid, and afterwards superficially, for the workmanship. Also columns, pilasters, cornices, facios, rustics, &c. The superficial measure

measure takes in all the pavings, floors, hearths, slabs, mantles, jambs, covings, &c. and the general dimensions of all labour; the run or lineal foot is used for all small abstracted mouldings, some carvings, frets, ornaments, &c. It is to be observed, that masons girt all their mouldings as joiners do, and take their dimensions in feet, inches, and parts. The greatest difficulty in measuring masons work is in chimney-pieces, on account of the various modes and prices, and the number of the different dimensions. But see the following example.

The way to measure masons work for labour is to measure what appears out of the wall, and (by many) the under bed of every course. The same likewise of all keys and bonds through the wall, as well as of chimney-pieces.

First, take the dimensions of the slab; then the mantle, or head-stone, being both of one length; add the two widths together, allowing an inch for the under-edge of the mantle more to the breadth. Secondly, take the length of the jambs, allowing an inch more to the length than is seen, for what goes behind the slab. If there be nosings and slips to the jambs, take the length as observed, and girt all that is seen for the width; next take the fire-stone hearths, covings, &c. and measure all that appears in sight. If the frieze, cornice, and ovolo be marble, they must be girted as the joiners do their work: the same of

of ornaments, frets, terms, flutings, &c. and all valued accordingly.

To measure Carvers Work.

Carvers work is all measured by the foot superficial and lineal: by the former all capitals to columns, large ornaments, festoons, foliage, flutings, frets, &c. the latter is used for all small mouldings, ribbons, husks, &c. and the dimensions taken in the same manner as observed in plaster cielings.

To measure Slaters Work.

Slaters measure their work by the square, the same as tiling, both with respect to hips, vallies, double eaves, courses, &c. This article therefore needs no farther comment than what has been already advanced.

Having finished the dissertations and strictures on mechanic powers, with the principles and properties of building in general, the five orders of architecture, art of measuring the different artificers works, &c. I shall now proceed, and relate what is necessary to be observed in the practice of different works as they occur in time and place. But before I begin, it will be proper to settle a criterion touching the universality both of the prices and estimations of the several works in a building, as well in the very remote parts of the kingdom, as those more contiguous to the capital,

capital, which I adjust by one general standard.

Though the manner of fixing and stating a matter of such consequence, and seemingly so full of exceptions, may appear an impossibility to some who have not enquired rationally into its principles; yet I hope to evince to every workman of experience, that one schedule of prices with respect to labour will serve, or at least ought to serve for every city and principal town in the kingdom. Various objections, I own, may be alledged against this universal system, but not one sufficient to overturn it.

LECTURE XV.

A new Plan for settling the Prices of Work done in a Building, all upon one Footing, both in London, *and every capital Town in the Kingdom.*

WHOEVER my reader is, whether architect, surveyor, master, or common journeyman, though he may smile at an attempt so extravagant, I humbly beg for a moment a suspension of his ridicule, till he maturely weigh this matter; after which, I am fully persuaded, he will find fewer objections to its feasibility than he at first imagined. If I consider the matter right, this great point has but two queries to be determined, which once answered will totally destroy every objection. The first is, whether a master in the country

country, (if his work be executed as well) ſhould have a leſs price than is paid for the ſame work when done by a *London* maſter in town? The ſecond is, whether a journeyman in the ſame caſe ſhould receive the ſame wages of a country maſter as are paid to journeymen in town? To the former of theſe queſtions I anſwer, yes; to the latter, no; and will endeavour to prove it. But before I give my own deciſion, I beg to introduce the opinion of a perſon of ſome abilities in one of the capital profeſſions in building, relative to this univerſal ſcheme. "My friend (ſays he) this plan of allowing as great prices to country maſters as thoſe in *London* will never anſwer, becauſe they are not liable to half the expences, nor does their work coſt them half the ſum in point of labour, on account of the ſcanty wages which are given in the country, all over the kingdom; they ſhould therefore have a price ſtipulated by a country ſurveyor, according to what the work may deſerve." Something of this kind I know runs in the notions of moſt people who think upon it.

That maſters in the country are not liable to ſuch great expences as maſters in town, I very readily grant, both with reſpect to yards, houſe-rent, and ſtowage for their different materials; nor has a country maſter in general half the buſineſs of a *London* one; and what is ſtill more to his diſadvantage, he is not required to finiſh his work with half the expedition.

expedition. It is therefore upon this topick we ſhould bend our thoughts: If a maſter in *London* can employ the year round 15 or 20 men, which may be called the medium, being as many above as under this number) and a maſter in the country employ but 7 or 8, and both have their work at one price, we ſhall then find that the *London* maſter will have it in his power to live conſiderably better, notwithſtanding the difference of expences, as well as the advantage of wages, which ſome think to be very great.

Every man of buſineſs, whether in town or country, ſhould be ſupported by his buſineſs, and reap ſuch an allowance or emolument from his profeſſion as may enable him to guard againſt the contingencies of a family, and in ſome ſort equal his induſtry. If it were poſſible for a country maſter to have as many jobbs as the maſters in *London* uſually have, and all required to be forwarded with the ſame expedition, their prices ought to be conſiderably lower: but as that is a circumſtance which never can happen, the reaſons are obvious, that in this firſt reſpect no difference can be made without a viſible injury, as will palpably appear upon enquiring into the difference of wages.

Secondly, that men in the country ſhould not have the ſame wages as journeymen in town, is evident from their want of experience both in the methods and nature of work. The reader, I hope, does not ſupppoſe that I would

would propoſe country wages to a man of the firſt merit in his profeſſion. A man thus qualified, who hath had ſeven or eight years practice in London among the moſt capital of his branch, and has not imbibed any but judicious methods of working, and been in the full practice of ſuch for ſome time, will be worth as much wages to a country maſter as a town one, and in reality more; eſpecially if he be empowered to forward his maſter's buſineſs by his own advantageous methods.

Though there are many good workmen in the country who have never ſeen *London*, yet thoſe compared to men of the above experience, will, in every point of practice, be more deficient in the courſe of a week's work than the difference of wages, ſuppoſing the one to have four ſhillings or five ſhillings per week more than the other.—I ſpeak not this from ſpeculation, but undeniable facts; having myſelf ſeen and examined into the nature of practice in almoſt every town in the kingdom, where I have ever found, that if the maſters were allowed the ſame prices with maſters in *London*, notwithſtanding the difference of men's wages, when oppoſed to the ſame number of men, a *London* maſter would have had the above advantage in point of profit; ſaving only this proviſo, that the men from *London* muſt be good, and ſuch as have had the foregoing advantages. It is true, that there are hundreds of men in *London* ſo bad, that one would think it almoſt impoſſible to

fellow

fellow them, or even ſuppoſe that they could have ſerved a proper time to any buſineſs; and how to account for this otherwiſe than from a want of attention to their real intereſt, or proper good, would almoſt puzzle the greateſt philoſopher. For it is certain, that all trades and employs are ſo familiarized, and have at their heads ſuch noble inſtructors, that with cloſe application even the weakeſt capacity may be poſſeſſed of ſuch points in practice as will enable him to deſerve the common wages. Thoſe that arrive at a greater pitch of merit ſhould be rewarded according to their induſtry.

There is one thing which ought to be mentioned to country journeymen, that is, the little reſpect they pay to compariſons and arguments touching men of *London* experience; for, ſay they, we have worked with men from *London* at ſuch and ſuch gentlemen's houſes, but could not find any material difference between them and us who had never been there. This I believe to be often the caſe, and reflects great weakneſs on the *London* maſters, for ſending to any country jobb, men who were not really proficients in their branch; for when maſters want a number of men to go into the country, they ſeldom enquire farther into their characters than in regard to their ſtability. And if carpenters have got a cheſt of tools, away they are ſent to finiſh ſomething in a peculiar manner to what could in any wiſe be done by country-men, when

perhaps ſome of theſe very men had not been ſix months in town.

It ought to be a fixed rule in maſters never to employ a man for a country jobb who had not approved himſelf an excellent workman; and moreover, he ſhould be of ſome remote county or ſhire to that the work is done in, to ſubvert the proverb of a prophet in his own country having no honour. I hope from theſe hints, that no reaſonable man will ſtart an argument againſt the queſtions above ſtated, but freely allow a right for country maſters to have the ſame prices as maſters in town. I do not mean ſuch as are exacted by ſome maſters, but ſuch as may be conſidered as juſt ones.

I believe, upon a thorough review of the wages both in town and country, we ſhall not (upon the whole) find much difference. In certain reſpects the country maſters have the advantage, eſpecially in ſome parts of carpenters work, ſuch as roofing, ſtairs, ſaſhes, floors, but in many other branches of building, they get conſiderably leſs by, through a want of experience in the journeymen (notwithſtanding their low wages) than the maſters do in *London*; not but there is room enough in both places for the journeymen's wages to be raiſed; and if this ſcheme be not ſhortly put in execution, I am perſuaded the conſequences will be very alarming to all maſters in the building branch.

It

It was a piece of the weakeſt policy in the maſter carpenters the laſt time the journeymen ſtruck for an advancement in wages, which was about ten years ago, that they did not comply with their eaſy demands; they would not then have had occaſion to fear the preſent mode of architects engroſſing the whole buſineſs into their own hands, which ſeems to be the general plan if ſome ſtep be not immediately taken to prevent it; and none ſeems ſo promiſing as to advance the journeymen's wages. The capital architects and ſurveyors who have adopted the plan of finding all materials, and of allowing only even principal maſters a ſort of prices like taſk-maſters for executing the work, do this through a knowledge of the exorbitant advantages which ariſe from work at the original cuſtomary prices; and as this method is put in practice by the firſt men in the kingdom, the inferior ſurveyors, in order to be in the faſhion, will ſoon follow their example; not that I mean to infer, that cuſtomary prices are exorbitant. If journeymen's wages were ſettled in proportion, the preſent luxury of the times would not admit of abatements in any profeſſion. The reader will obſerve, that ſince the prices were ſettled for all works in the building branch (though they every year vary in ſome particulars) every buſineſs is improved in point of practice above one third; nay, in ſeveral points and parts, the work is done for one half the expence to maſters which it coſt

them twenty years ago, and all through the assiduity and study of the journeymen, though the masters will not give them any more wages; which sets them upon an exact par with the surveyors in point of disposition; each striving to engross the whole. The latter not being content with the great allowance of five per cent. for the works they survey, but wanting to double it by the advantage of finding materials; and as they have it in their power to colour their proceedings to the gentlemen with a view of parsimony there is no doubt of their carrying their point in every respect; this will only be paying the masters in their own coin, for their avaricious dispositions, in condemning to a life of slavery and indigence men of abilities, from whom they derive their chief support. For, considering the present exorbitant price of provisions, and every other incident to life, no man who has a family to maintain can by sixteen shillings a week more than exist; nor a single man ever get a coat to his back, unless (if I may be allowed the phrase) he spares it out of his belly: therefore what better than slavery can we call it? and yet at the same time the masters enjoy a profit (which results chiefly from these mens labour) equal to the fortunes of some of our nobility. Though this may seem strange to some, I have had undeniable facts of many masters in the building branches, whose business is worth 2000*l. per annum*, at this time. I appeal therefore to every feeling heart,

heart, whether this be not a matter of great consideration, and in no respect beneath the attention of legislature.

If it were not that I might be thought too particular, I would state the case of a carpenter, and leave the world to judge of the severity of his situation; and how unthinking a father must be, who proposes any emolument to a son who is apprenticed to this ingenious, and well deserving the name of liberal art, if he has not almost as much to put him in possession of, as will be a support to him without business.

Every man, in the country in particular, from whence most of the journeymen in town generally have their origin, in the raising of a family suits his childrens occupations according to their strength or genius; though, at the same time, he with favourable incitements makes his will a sort of choice of their own. The boy that seems athletic and sensible, or quick at learning school-exercises, he proposes for a carpenter, and says, if he turns out well, that there is no doubt but he will make his fortune.—Yes, adds the fond father, I make not the least doubt but he will have as much business as Mr. Whole-deal, our neighbour, and cut as great a figure in the world. All this he settles without allowing for the least casualty; and no consideration of the improbability of his getting to be a master at all, without great interest and large connections, provided only he gets

to be what is uſually called a good hand in his buſineſs.

Well:—We will ſay the lad is bound apprentice, for which his father gives 20l. finds him in his clothes, and perhaps waſhing; and ſome fathers are alſo obliged to find their ſons tools during their ſervitude. But this we will omit; and take the expence of his apprenticeſhip, clothes, ſpending-money, and the 20l. he gives to be inſtructed in his buſineſs, to amount to near 100l.—and when he is out of his time, through the little practice allotted to apprentices, and the many requiſites to be attained before he can have any idea of this extenſive branch (ſave only a little uſe of his tools) he is almoſt as much to ſeek as when he firſt went apprentice; except with this difference, that he has learnt as much as gives him reaſon to know that he muſt learn ten times more before he is fit to be a maſter. Thus he commences journeyman with a view of getting his buſineſs, and works for a year or two in the country; ſtill he finds himſelf far ſhort of what he wants, and nothing now will ſerve but coming to *London*; for there, ſays he, I ſhall have practice enough, and ſee through the whole of my buſineſs three or four times a year. When he gets to *London*, the great object is a cheſt of tools, which he either muſt be poſſeſſed of, or he cannot be forwarded in the leaſt in his buſineſs.—If his father be in circumſtances, application is made, and ten guineas are re-

mitted to procure him the neceſſary implements; having got theſe, he naturally goes to a good ſhop, there by degrees he creeps on for perhaps two years before a good jobb is put into his hand; if he be aſſiduous, and turns it quick out of hand, he is kept at that ſort of work as long as he ſtays there: he then naturally removes to another place, and ſees different methods; but not having capability or practice to judge for himſelf, is led by the dictates of every foreman, till by cloſe application to his room, learning to draw all the time, and with a continuance of ſeven years in *London*, he is enabled to ſay, that he is a good journeyman, and can execute well any deſign or drawing given.

By the time this is done, nine years are elapſed after his apprenticeſhip. Perhaps his father may be dead; the ſituation he propoſed for him, occupied by another; the connections and families whoſe intereſt he depended on, ſcattered, and no likelihood of doing any good in the country; the filial tenderneſs too of his parents, by long abſence, is probably abated; and as there is no chance of his being a maſter there, his friends adviſe him to do ſomething in *London*. But ſuppoſing this not to be the caſe, and that there be a chance of his being a maſter in the country, when he is qualified, as every man will (if there is a poſſibility) naturally tend towards home, where his friends or intereſt lie, eſpecially if he lives to a thinking age: the gay

luxuries of the town may indeed for a time attract, and lull a man into a dream of insensibility; but once awaked from this, his thoughts immediately turn upon his happiness, which can in no wise be established but where his interest lies.—Supposing the above, therefore, not to be the case, yet all this time, if he has the opportunity before observed, he is not in the least qualified for the undertaking. "Why not?" says the father; "if he can do any thing well, he is certainly fit for a master." To this I answer, No. For as to the principal requisites of a master, he is still quite at a loss for them; such as estimating the consequence of building in general, knowing the value of the different artificers works, their modes of measurement, and the established maxims of practice in all the branches; without which he will ever be at a loss:——and how to come at these is almost as difficult as the practical part of his business. There is no way to make himself master of them but at a great expence; or unless he be qualified to commence clerk to some great shop, where he may have the advantage of over-hawling his master's books and connections. By such an opportunity pursued with diligence, and by comparing the remarks within his own experience, he may in time fish out sufficient knowledge to enable him to practise as a master, if he have wherewithal to push himself forward. But then there is the hazard again of procuring business, and other incidents

incidents in life, before a man can be aſſured of getting a proper proviſion for a family.

Thus juſt at the time when other profeſſions, which have opportunities and circumſtances in life, are thinking of retiring, a carpenter and joiner has learnt only juſt enough to ſet up maſter; and all this time the perſon mentioned muſt be cut out for buſineſs, void of every principle of extravagance, or he could not arrive to it in any time during the courſe of his life, but be confined to a ſtate of ſervitude and hard labour as long as he lives; which is the unhappy caſe of hundreds at this time in *London*. Numbers, to my knowledge, who have moſt of the capabilities mentioned, and have undergone the ſame regimen to attain them, are now working for the poor pittance of ſeventeen or eighteen ſhillings per week; and becauſe they miſtook their path, and entered into a flattering ſtate of happineſs by marriage, before they were well apprized of the fatal conſequences, are now conſigned to all the horrors of poverty and deſpair, never to be relieved till death.

Any reaſonable man, who will properly conſider the above-mentioned caſe, will rather approve than condemn my undertaking, for endeavouring to give every journeyman a knowledge of the principles and advantages of his buſineſs. None but the maſters can diſlike it; and only thoſe of them who are not content with a tradeſman's profit. But let who will diſapprove of the plan, I am conſcious

ſcious of the rectitude of my intention, and have long conſidered it as an indiſpenſable duty to do thus much for the univerſal benefit of mankind.

LECTURE XVI.

OF THE PRACTICE OF BRICK-WORK.

THE utility and common practice of building all our edifices of brick, both in *London* and the country, ariſes from motives too obvious to need explanation; it being generally allowed that brick is much the cheapeſt, as well as the moſt eligible ſubſtance that can be invented for the purpoſe, both in point of beauty and duration, and inferior to nothing but wrought-ſtone.

The great principle in the practice of brick-work lies in the proclivity, or certain motion of abſolute gravity, cauſed by a quantity or multiplicity of ſubſtance being added or fixed in reſiſtible matter; therefore naturally tends downwards, according to the weight and power impreſſed. From which obſervations, the requiſite inferences may be drawn, and ſuch remarks made, as may enable the journeyman to erect his works with ſuch accuracy that no bad conſequences can attend them, and, moreover, ſo as to avoid unnatural ſettlements.

And firſt, it may not be amiſs to conſider the motive of the above-mentioned proclivity; which is chiefly cauſed through the yielding

mixture of the matter of which mortar is composed, and cannot well be reduced to any system of certainty; because the absolute weight of a brick, or any other substance laid in mortar, will naturally decline according to the substance or quality of it; wherefore particular care should be taken, that it be of a regular quality all the way through the building; and likewise that the same force be used to one brick as another; I mean the stroke of the trowel; a thing, or point in practice, of much more consequence than is usually thought: for if a brick be acted upon by a blow, such blow will be a greater pressure upon it than the absolute weight of twenty bricks; and before these can be properly laid, in form and arrangement, with the advantage, of the weather in a favourable season, they may be so dried or consolidated that no settlement can ensue from other defects than that of an oversight in the foundation, which must be adhered to, and prevented by the methods laid down for foundations, in my Lecture of strength. The many bad effects which arise from mortar not being of a proper quality, should make masters very cautious in the preparation of it, as well as the certain quantity of materials of which it is composed, that the whole structure may be of one substance.

There is one thing which often causes a bulging in large flank-walls, especially when they are not properly set off on both sides; that

that is, the irregular method of laying bricks too high on the front edge; this, and building the walls too high on one side, without continuing the other, often cause the above defects. But of the two evils this is the least; and bricks, if any thing, should incline rather to the middle of the wall, that one half of the wall may be a shore to the other. But this method again, when too much followed, will be more hurtful than beneficial; because the full width of the wall doth not take its absolute weight, but entirely removes the specific gravity from its first line of direction, which in all walls should be perpendicular and united; whereas if the above method be stretched to excess, and the walls have a superincumbent weight to bear adequate to their full strength, a disjunctive digression is made from the right line of direction; the conjunctive strength becomes divided; and instead of a whole or united support from the wall, its strength is separated in the middle, and takes two lateral bearings of gravity; each sufficient for the purpose; therefore, like a man over-loaded either upon his head or shoulders, it naturally bends and stoops to the force impressed: in which mutable state the above grievances usually happen.

Another great defect we frequently see in the fronts of houses is in some of the principal ornaments of brick-work, such as arches over windows, &c. and which is too often caused by a want of experience in the rubbing

rubbing of them; this is the moſt difficult part of the branch, and ought to be very well conſidered.

The faults I mean, are the bulging or convex ſituation we often ſee arches in, after the houſes are finiſhed, and ſometimes looſe in the key or centre bond. The firſt of theſe defects, which appears to be cauſed by too much weight, is in reality no more than a fault in the practice of rubbing the bricks too much off on the inſides: for it ſhould be a ſtanding maxim (if you expect them to appear ſtraight under their proper weight) to make them the exact gauge on the inſide, ſo that they bear upon the front edges: by which means their geometrical bearings will be united, and all tend to one centre of gravity.

The latter obſervation, of camber arches not being ſkewed enough, is an egregious fault; becauſe it takes greatly from the beauty of the arch, as well as its ſignificancy. The proper method of ſkewing all camber arches ſhould be one third of their height. For inſtance: If an arch be 9 inches high, it ſhould ſkew three inches; one of twelve inches, 4; one of 15 ditto, 5; and ſo of all the numbers between thoſe. Obſerve, in dividing the arch, that the quantity conſiſts of an odd number: by ſo doing, you will have proper bond; and the key-bond in the middle of the arches: in which ſtate it muſt always be, both for ſtrength and beauty. Likewiſe obſerve, that arches are all drawn from one centre;

centre; the real point of camber arches is got from the above proportion. Firſt, divide the height of the arch into three parts; one of which is the dimenſions for the ſkewing; a line drawn from that through the point at the bottom to the perpendicular of the middle of the arch, gives the centre, to which all the reſt muſt be drawn.

There are many other difficult jobbs in brickwork: ſuch as groins, niches, circular arches upon circular plans, &c. all which I ſhall mention in their time and place.

And, firſt, of Brick-groins.

A groin is the interſecting or meeting of two circles, &c. upon their diagonal elevations drawn on the different ſides of a ſquare, or any other figure, and whoſe principle of ſtrength lies in the united force of elevation; divided by geometrical proportions to one certain gravity; which is the centre to which all the bearings tend.

The difficulty that attends the execution of a brick-groin, lies in the peculiar mode of appropriating proper bond at the interſecting of the two circles as they gradually riſe to the crown, to an exact point; in the meeting or interſecting of thoſe angles will be formed a kind of rib in the inſide, which ſhould be particularly ſtraight and perpendicular to a diagonal line drawn upon the plan.

There is no definition of a thing of this ſort, either by lines or deſcription, equal to what

what will occur to the learner in the practice of them. After the centres are set, let the bricklayer apply two or three bricks to an angle; by these means he will effectually see how to cut them as well as the requisites of bond.

There is nothing so certain as practice for the solving any difficulty; it is by this axiom that every proof is founded, and without it the most flagrant idea of lines, and theoretical speculation, will in many cases be defective; because a false notion, or a wrong conception, may lead the wisest man into an error.

It is upon this principle of practice I propose to bring my analysis to the understanding of the most illiterate; by eradicating all superfluous lines set down by architects, and only pointing out such rules of reason and practice as may suit the weakest to proceed by. Though I must own that lines are the bases of all mechanick powers, arts, and practices; yet there are hundreds of useful members of the community who never have it in their power to acquire the properties of one; however, with practical instructions they may make useful journeymen, and be taught to do any thing tolerably: but these instructions must be given them in a manner suited to their capacities and (as I before observed) by practical rules.

To pretend to show numbers of bricklayers lines for doing their work, you may as well

well ſhew them Arabic: the ſame may be ſaid of hundreds of carpenters, &c. If it were poſſible for journeymen to underſtand beyond what I have mentioned, we might long have bid adieu to all commentators; ſeeing *Palladio* has left us rules ſufficient for men to work by. But theſe would not anſwer the purpoſe of the ignorant; nor has any author yet, either ancient or modern, been clear enough for a common journeyman to underſtand them; there being always ſome points, which are the requiſites that lead directly to the matter omitted; and which but few, that have an inferior genius to the author himſelf, can find out; yet are they ſimple enough in the main; but for want of being particularly noticed, have hitherto eſcaped thouſands. To ſet all theſe matters in a proper degree of light, is the purport of the following deſign; and I ſincerely wiſh it may have as good an effect as it is univerſally intended.

But to return to the groins. The workman muſt obſerve, that the manner of turning groins with reſpect to the ſides, is the ſame as in other arches and centres, except in the angles, which muſt be traced for their properties, as I have obſerved by applying the bricks; and if the arch is to be rubbed and gauged, you muſt divide each arch into an exact number of parts, and extend the lines till they meet in the groin: by theſe means you will eaſily find the curve for the angle,

angle, from which you muſt make your templets: obſerve, in fixing the centres, that the carpenters raiſe them ſomewhat higher at the crown, to allow for ſettling, which frequently happens; ſometimes by the preſſure upon the butments, at others from the length of the crown.

Obſerve alſo in building of vaults, that the piers or abutments be of ſufficient ſtrength; all abutments to vaults, whether groined, or only arched, ſhould be one ſixth of the width of the ſpan; and if there be any great weight to be ſuſtained, bridgings of timber ſhould alſo be framed to diſcharge the weight from the crown of the arch: after a vault, or groin is finiſhed, it is highly neceſſary to pour on a mixture of terrace, or lime and water, on the crown; and to give it ſome little time to dry, before you ſtrike the centres, in order to cement the whole together.

Rough groins have no more value put upon them than common vaults, which are included at per rod with common brickwork, except the angles of groins, which are meaſured after the run lineal, and ſometimes allowed for by ſurveyors at 1s. per foot; many maſters even charge 1s. 2d. But as the ſtuff is reckoned and valued in the common meaſurement, and a man will cut and turn 10 feet run in a day, 8d per foot ſhould be the ſtipulated price for rough groins: which will pay for the waſte of ſtuff, and allow a ſufficient profit to a maſter.

Groined vaults rubbed and gauged are worth 1s. per foot ſuperficial, and the run of angles 2s. 6d.

Of a Niche in Brick-work.

A niche is the inner or concave quarter of a globe, and uſually made in walls on the exterior parts of a building, to place figures or ſtatues in. The practice of this in brick-work is the moſt difficult part of the profeſſion, on account of the very thin ſize the bricks are obliged to be reduced to down at the inner circle, as they cannot extend beyond the thickneſs of one brick at the crown or top; it being the uſual, as well as much the neateſt method, to make all the courſes ſtanding.

The moſt familiar way to reduce this point to practice, is to draw the front, back, &c. and make a templet of paſteboard, after you have divided the arch for the number of bricks. The reader is to obſerve, that one templet for the ſtanding courſes will anſwer for the front, and one for the ſide of the brick; and at the top of the ſtraight part, from whence the niche takes its ſpring, you muſt remember to make a circle of the diameter of 8 or 9 inches, and cutting this out of paſteboard alſo, divide it into the ſame number of parts as the outward circle; from which you will get the width of your front-templet at the bottom. The reaſon of this inner circle is to cut off the thin conjunction

tion of points which muſt all finiſh in the centre, and which in bricks could never be worked to that nicety; it being impoſſible to cut bricks with any accuracy nearer than half an inch thick: the bricks muſt be lying within the inner circle. It will be neceſſary to have one templet made convex, to try the faces of bricks to, as well as the ſetting of them when they are gauged.

The ſtone you rub the faces of the bricks upon, muſt be cut at one end in the exact form of the niche, or it will be impoſſible to face them proper. The bevel of the flat ſides of the bricks is got by dividing the back into the number of parts with the front, and all ſtruck to the centre; from the circle of the front of one brick ſet your bevel, which will anſwer for the ſides of the whole. Obſerve, that the bricks hold their full gauge at the back, or when you come to ſet them you will have much trouble.

Jobbs of this kind are very rare, and when they happen, ſhould bear a price equal to their value, which ought not to be leſs than 3s. per foot, and allowed double meaſure.

A Circular Arch upon a Circular Plan.

There is not that difficulty in an arch of this conſtruction in brick work, which is uſually thought of; the principal thing to be conſidered, is the ſcheme for ſtriking the front of the bricks, which when once pro-

perly underſtood, will render the practice exceedingly familiar.

There is another conſideration alſo to be obſerved, which is the ſoffit of the bricks to theſe arches, and which muſt bear the exact gauge behind as before, in order to ſecure the ſtrength and key, that the arch may have no inclination to a centre otherwiſe than what tends to its gravity. The beſt practical method I can give, is, after you have divided the arch, and ſettled your bond in front, to make two moulds to the ſweep of the wall, then fix two uprights of wood a little above the top of the arch; one at the top, and the other to be moved down to the top of the courſes as they gradually riſe: after which with a rod, with a prick in the end, clapped cloſe to thoſe two ribs, ſtrike the top-ſides of every brick; the under-ſide may be marked by the preceding brick; and in this manner proceed all the way, till you get to the top, which will give the exact curve required to the wall and perpendicular to the ground plan.

A cimma elliptical arch, upon the above plan may be executed in the ſame manner reſpecting the front, and ſoffit likewiſe. Arches which ſplay in the jambs, and riſe both to one height, muſt be reduced to practice in the following mannner: Firſt, divide the arches on each ſide into an exact number of bricks; and having drawn the width of the wall and laid down the arches on both ſides,

 let

let fall perpendiculars from the different ends of the bricks on both ſides, and draw parallel lines into each by the ſplay of the wall, which will give the exact ſize of the bricks in the ſoffit, and likewiſe the ſplay of the face of the bricks on both ſides.

Of the Quantity of Materials to a Rod of Brick-work.

The requiſite quantity of materials to a rod of brick-work, which is the ſtandard for valuing, as well as taking dimenſions; the maſter's prices, and thoſe ſtipulated by ſurveyors, come next within our notice, as well as the juſt calculation for *London*, and every capital town in the kingdom, diveſted of all the errors of ſurveyors, and extravagant exactions of ſome maſters.

And firſt, it will not be amiſs to mention, that a rod is a meaſure of $16\frac{1}{2}$ feet, which multiplied into itſelf contains 272 feet and one quarter to one brick and a half thick, which is the ſtandard by which the price is fixed: let the wall conſiſt of what number of bricks ſoever in thickneſs, they are always reduced to a ſyſtem by the following rule;

Multiply the ſuperficial contents of the wall by the number of half bricks it contains in thickneſs; and divide that product by 3; the quotient will be the contents in feet, to the ſtandard.—Laſtly, divide that quotient by

272, the number of superficial feet in a rod, and the last quotient will be the contents in rods, and the remains feet. See the example:

Suppose the dimensions of a wall to be 64 feet 6 inches by 24 feet 6 inches, and 3 bricks thick, first multiply 64 feet 6 inches by 24 feet 6 inches, the product will be 1580 3, which I multiply by 6, the number of half bricks the wall contains; the product is 9481 feet 6 inches, which I divide by 3, the number of half bricks in the standard; the quotient is 3163 and 2 parts; which I divide by 272, the number of superficial feet in a rod; the last quotient is 11 rods and 71 feet.

```
      64   6
      24   6
    ---------
     256
    128
      32   3
      12
    ---------
    1580   3
           6
    ----------------
3 | 9481   6 | 316
    9
    ------
     4
     3
    ---
     18
     18
    ---

272 | 3160   2 | 11
      ----
       440
       272
      ----
       168
      ----
```

Whenever it happens that there are large remains of feet, you muſt divide them by 68, the number of feet in a quarter of a rod, which will bring you nearer, if you have but one number: if many, add them all together: and this rule will ſerve for every ſubject. According to a wall of the above dimenſions, the quantity of reduced brick-work is 11 ſquare, 1 quarter, and 3 feet, as in the margin.

68 | 168 | 2
136
———
32

Sq.	Q.	Ft.
11	1	3

Note, Though a rod contain $272\frac{1}{4}$ feet, the quarter is always rejected: divide then by 272, which is near enough for brick-work, as a quarter of a foot, ſtuff and labour, cannot be worth more than two-pence, which is too trivial to mention in an eight pound matter. The ſame of the parts of a foot to be divided, as in the above example.

Having given an example of meaſuring brick-work, in order to come at the value we muſt conſider the quantity as well as the quality of the materials along with the exact time it takes to execute it.

And firſt, of materials: The reader is to obſerve, that to every rod of brick-work, 4400, and of ſome (as bricks vary much in ſize) 4500 bricks are required, with one load of lime, or 32 buſhels of lime, and two loads of ſand, which is the neareſt general calculation that can be made. I have, notwithſtanding, ſeen bricks of ſuch a ſize that 4000 of

them would have walled a rod; but thoſe are rarely to be met with: we muſt abide therefore by the foregoing number. The ſame likewiſe of lime and ſand, which may vary a little according as they are in goodneſs.

There are two ſorts of lime; the one made of chalk, the other of ſtone: the latter in point of ſtrength and quality deſerves much the preference. There are alſo different ſorts of ſand, and equally good; but that which ought to be preferred for building is river-ſand, and is much the beſt in a ſtrong current. Of this you may put three parts of ſand to one of lime that is made of ſtone; if of chalk, only two of ſand, and one of lime. There is a kind of white pit-ſand in many counties; but it is not ſo good as red.

The reader is to obſerve, that with regard to materials no univerſal ſtandard can be found, becauſe bricks and lime vary in every county; I ſhall fix a price therefore for a rod of brick-work in *London*, and afterwards make a table to ſerve the country, according as materials vary in value. But firſt we are to enquire into the labour which a rod of brick-work requires.

The reader will allow, that in order to ſettle a general plan for labour, we muſt either account the mean proportion of time, or ſtipulate the beſt wages to the leaſt that reaſon can allow; which, to a good journeyman of 3s. per day, will take four days, and the like quantity or length of time to a labourer, be-

ſides,

ſides, making the mortar, &c. The reader is next to obſerve, that bricks in *London* are from 1*l.* to 1*l.* 10*s.* per thouſand; we ſhall not heſitate therefore in this, but take a mean of 1*l.* 5*s.* for the ſtandard-price, and reckon lime at 5*d.* per buſhel, and ſand at 4*s.* per load; which are about the neat prices. The reaſon I chooſe to mention lime by the buſhel, is to give a clearer light into this matter than I ſhould by calculating it either by the bag or hundred, becauſe every county hath a juſt knowledge of the buſhel, and few of bags and hundreds. But to the point:

	£.	*s.*	*d.*
4,500 bricks, at 1*l.* 5*s.* per 1000, are — —	5	12	6
32 buſhels of lime, at 5*s.*	0	13	4
Labour of trowel-hand at 3*s.* per day, 4 days, —	0	12	0
Ditto for labourer at 2*s.*	0	8	0
Making the mortar to ditto,	0	3	0
	7	8	10

By the above calculation we find that 7*l.* 8*s.* 10*d.* is the neat price which a maſter pays out of his own pocket, beſides the loſs of tools, as ſhovels, ſcreens, the wear of cords, poles, puttocks, &c. which are always upon the waſte, together with boards, his own time, and the lying out of his money; for materials therefore of the above quality a maſter in juſtice ſhould have per rod 8*l.* 10*s.* But in order to come at a real ſtandard of prices for brick-work in any county, I beg the

the reader to have recourse to the following table, calculated as universal, allowing the master for lime, sand, and making the mortar, 1*l.* 3*s.* and for labour 1*l.* 5*s.*

An universal Table of Brick-work, allowing 1l. 3s. *Mortar, and* 1l. 5s. *Labour.*

Bricks per 1000.	Mortar & labour.		The price.		
S.	*£. s.*		*£.*	*s.*	*d.*
At 10	2 8	is	4	13	0
11	Do.		4	17	6
12	Do.		5	2	0
13	Do.		5	6	6
14	Do.		5	11	0
15	Do.		5	15	6
16	Do.		6	0	0
17	Do.		6	4	6
18	Do.		6	9	0
19	Do.		6	13	6
20	Do.		6	18	0
21	Do.		7	2	6
22	Do.		7	7	0
23	Do.		7	11	6
24	Do.		7	16	0
25	Do.		8	0	6
26	Do.		8	5	0
27	Do.		8	9	6
28	Do.		8	14	0
29	Do.		8	18	6
30	Do.		9	3	0

The above table is calculated to serve the country, and ought to be the standard in town,

town, when there are no extraordinary exceptions, ſuch as fronts with particular breaks, which are attended with much trouble, &c.

If a maſter-bricklayer eſtimate his work all at one price, as fronts, foundations, and party-walls, one part will make amends for the loſs of another. But the price ſhould be what I have mentioned prior to the table; though maſters would grumble at it, becauſe allowed only 1*l.* per rod profit, which I think very ſufficient; for by this rule, if a maſter can but employ 12 trowel-men the year round, his buſineſs will be a good 500*l.* *per annum*, allowing 100*l.* for bad debts, and keeping up his ſcaffolding.

Whether this be ſufficient or not I leave to the judgement of the world.—But I ſay, if from ſuch prices (which are conſiderably leſs than many maſters have) theſe genteel profits ariſe, what ſhall we ſay to 10*l.* and 12*l.* per rod, which I have known many bricklayers charge for common brick-work? but the laſt is exorbitant, and ought to be utterly aboliſhed.

There are, indeed, particular jobbs, ſuch as warehouſes of a particular height, which ſtand cloſe to the *Thames*, where one labourer is not half ſufficient to ſerve one bricklayer, and where double the trouble is required to erect the ſcaffold, &c. In ſuch caſes 12*l.* per rod may not be amiſs.

I would

I would not willingly infer, or be suppofed to infinuate, that the above prices fhould be lowered; but will take the liberty to fay, that if a mafter be allowed 9*l.* or 10*l.* per rod, he ought to augment his journeymen's wages; a thing which ought to be maturely confidered in every branch of building.

I make no doubt but fome people will wonder how I can fo eafily reconcile the giving as much for labour to a country mafter as a *London* one, in a bufinefs like a bricklayer, and fo eafily attained. To the perfon who makes this objection, I give the following anfwer; that there is a flight in brickwork as well as in every other practice, and that bricklayers in *London* fhould do one third more work than in the country is ever defired: befides, with refpect to labourers and their prices, which in *London* are confiderably more than the country, and with juftice too, that is another point to be confidered; for could we have a country labourer in *London*, we fhould find he would not be able half to ferve a bricklayer without a year's experience. A rod of brick-work in the country is, by men who have not had *London* practice, $5\frac{1}{2}$ days work, and in fome places 6; nay, I have even known a bricklayer in the country, and one who was efteemed a good workman, to be 8 days walling over a rod, and all this time a labourer to attend him; which, if we rightly confider, will produce

the

the country maſters leſs profits by much, and not leave work for half the number of men.

From a gentleman who finds his own materials, ſcaffolding, &c. a maſter ſhould have from 1*l.* 8*s.* to 1*l.* 16*s.* per rod labour; according to the goodneſs of the work. The ſtandard price by many ſurveyors is 1*l.* 10*s.* The maſter's prices, where no ſurveyor is concerned, are from 1*l.* 16*s.* to 1*l.* 18*s.* This will allow for men to have 3*s.* 6*d.* per day, which ought to be the journeymen's price, as bricklaying is but an half-year buſineſs.

Of Tiling.

There being nothing in the practice of Tiling beyond what a journeyman may have acquired in the courſe of his apprenticeſhip, and as things of more material conſequence will ſhortly come within our deſcription, I beg to be excuſed ſpeaking further on this ſubject than in regard to the quantity: and that the principal judgement of it lies in the peculiar pitch of raiſing the eaves, ſo that the tiles may lie cloſe at the bottom-edge. There is alſo ſome little difficulty in laying a valley with plain tiles; but after the practice of one or two, it is eaſily acquired. The ſame alſo in regard to paving with bricks.

Plain tiles to a ſix inch gauge will take to cover a ſquare ſeven hundred and ſixty, one peck of tile-pins, two buſhels of lime, five buſhels of ſand, five hundred nails, one bundle of laths, and one day's work of a trowel

trowel hand, and at leaſt one labourer. We will allow the plane tiles per thouſand to be from 17*s.* to 22*s.* but will here reckon them at 1*l.* per ditto.

		s.	*d.*
700 plain tiles are	—	15	0
2 buſhels of lime, at 5*d.*		0	10
5 buſhels of ſand we will call		0	6
400 of nails, at $1\frac{1}{2}$*d.*		0	$7\frac{1}{2}$
One bundle of oak laths, 1*s.* 10*d.* of fir 1*s.* 3*d.*		1	3
Hair —	—	0	2
Bricklayer, one day		3	0
Labourer, ditto	—	2	0
One peck of tile-pins		0	8
		£.1 4	$0\frac{1}{2}$

By the above calculation we ſhall find the neat price a ſquare of plain-tiling ſtands a maſter in is 1*l.* 4*s.* $\frac{1}{2}$*d*; to a piece of work therefore of this gauge, we muſt allow a maſter per ſquare 1*l.* 9*s.*—to a ſeven inch gauge, 1*l.* 6*s.*—to an eight inch gauge, 1*l.* 3*s.*

Pantiles are from 3*l.* to 3*l.* 10*s.* per thouſand, 150 of which will cover a ſquare. Gutter-tiles from 11*s.* to 15*s.* per hundred. Dutch glazed pantiles from 12*s.* to 16*s.* per hundred. If we reckon 100 pantiles therefore at 7*s.*

	S.	d.
150 will be — —	10	6
100 nails — —	0	5
Lime, hair, and ſand, for pointing,	1	6
Laths to a ſquare —	1	8
To tiling and pointing, a trowel-man and labourer, one day,	5	0
	19	1

Thus we find the advance-money to a ſquare of pantiling is 19*s.* 1*d.* the maſter's price therefore ſhould be 1*l.* 4*s.* and with Dutch pantiles 1*l.* 12*s.*

	£.	s.	d.
The maſter's prices for plain tiles are for a 6 inch gauge,	1	11	0
By ſurveyors, —	1	8	0
To a 7 inch ditto, maſters,	1	8	0
Surveyors —	1	6	0

Old plain tiling ripped and new laid, from 15*s.* to 18*s.* per ſquare. Pantiling with old pantiles, 10*s.* or 11*s.*

Of Paving.

	S.	d.
Paving with place-bricks laid flat, and without mortar, per yard,	1	$2\frac{1}{2}$
Ditto with mortar, —	1	5

Note, 32 bricks will pave 1 yard, 64 edgeways.

Paving

	S.	d.
Paving with white brick	1	6
New Flanders brick-paving per yard, (Note, Flanders bricks are 1*l.* 1*s.* per thousand) —	3	6
9 inch pavement-paving, per yard,	2	6

For all rubbed and gauged arches, either of red or gray stocks, the master's charge per foot superficial, is from 1*s.* 4*d.* to 1*s.* 6*d.* Note, a good journeyman will rub, gauge, and set in putty, one day with another, 8 feet; the materials to ditto are worth per foot superficial 4½*d.* Thus we shall find by this sort of work a master may well afford to advance the wages.

	S.	d.
Surveyors allow per foot	1	4
Plain facios per foot rubbed	1	0
By surveyors sometimes only	0	10
Master's charge —	1	2
Brick cornices per foot superficial	3	6
Some charge —	5	0

Having said thus much of bricklayers work, I shall mention two or three necessary matters to journeymen, and proceed with my next lecture; which is, first, that they have respect to the building in general; and be not backward in assisting with bond timbers, lintels, wood-bricks, discharging-pieces, tassels, &c. but put all in their proper places, which they should be as well apprized of as the carpenter,

penter, both as to conſequence and place. The firſt place of bond-timber, in every ſtory, is for the ſkirting or baſe-moulding to be fixed to; the next for the ſur-baſe. This is of uſe as to ſtrength. In the next place there ſhould always be a chain of bond-timber between the floor or ſtory-plate, and the ſur-baſe; to run quite through the windows, &c. well bound in the angles; and not cut off in the windows, till the houſe be covered in; beſides it will be of uſe in the windows to ſcaffold upon.

Secondly, that the bricklayers omit not to try if their work be level every four or five courſes; a matter of great conſequence, as well for the ſtrength of the fabric, as the benefit of the carpenters, in laying on their plates for the floors; that inſide walls be as ſtraight as thoſe without; chimnies, quoins, and breaſts, perpendicular: that they be particularly careful in ſetting ſaſh-frames, if they ſtand in the wall, both as to regular margins from the outward part of the wall, as well as exactly perpendicular: for on this laſt article depends all the beauty of the inſide work; every thing being fixed from, and guided by the ſaſh-frame: thus the leaſt defect in this often cauſes ſhutters to be framed of different widths, as well as obliges the carpenters to make unneceſſary furrings.

And laſtly, of the beauty of walling; this depends on a regularity of bond, an exact point, and cleanlineſs of execution; with re-

gard to a regular bond, I mean the exact uniformity which one course bears to another: so that the heading joints, both of header and stretcher, may appear straight one above another, from the top to the bottom; and so regularly broke every other course; that the joints be of a regular thickness all the way up, and not bigger than $\frac{5}{8}$ of an inch: that the fronts under windows do not exceed in thickness the inside of the sash-frame, to prevent the carpenters from shaking the whole front by cutting away for their dado: that they be also careful to tie the angles of the building, these being the pillars and strength of the whole.

LECTURE XVII.

OF THE PRACTICAL PART OF PLASTERERS WORK.

THE plastering branch is practically considered under two heads, relative to the distinction of workmen, viz. ornament, and what are called cornice hands; both having an extensive field for cultivation. To the former of these ingenious departments is referred the study of all nature, to the latter the exact symmetry and beauty of architecture.

The principal thing in the practice of common plastering, is a thorough knowledge of the quality of materials; and how far they are subject to the inclemency of weather; because on this particular depends the composition

ſition of the ſtuff; and how to apply a certain quantity or gauge of plaſter, to a quantity of lime and ſand, ſo that it may anſwer in all ſeaſons of the year. Thoſe who would deſire to have their work appear ſound and firm, will pay a reſpect to this particular; for it is certain, that in winter, or very damp weather, ſtuff will require a double gauge of plaſter, more than the exact quantity neceſſary to be applied in all common ſtuff for cornices, ciel-ings, &c. which is the ground of all works of this ſort; and if in any wiſe defective, will be too powerful for the ſetting or finiſhing of putty, that is applied over the whole; and which ſhould appear without crack or bliſter.

Plaſter is of a very aſtringent quality; ſuch of it which is good, is an immediate cement, like terras. But though work be forced by an augmented quality in unſeaſonable wea-ther, for my own part, I would prefer a good ſeaſon for natural drying, to any thing con-fined by artificial means, and would con-ſider one bag of plaſter in May worth ten in January or February, either for cornices or thin boſſing of ornaments. The way and time to mix plaſter with ſtuff, is to do it when you lay it on; in which caſe it will have all its ſtrength. Plaſterers themſelves know well enough the uſe and mode of mixing their ſtuff; but as I propoſe my book to be of univerſal benefit, I beg leave to mention two or three things relative to the quality and quantity of materials, which may be ſerviceable to many

workmen who do plafterers work in the country, though beneath the notice of an eftablifhed plafterer.

The mode of appropriating ftuff for the firft coat of cielings, is to take one quantity of lime to three of fand. Note, the beft fand for cielings, walls, &c. is red pit-fand; which is of a rough conjunctive quality, and the leaft fubject to crack of any. For ftucco, or what is called finifhing, mix one of lime, and another of fand; the beft for ftucco is river-fand, being much fharper, and fets, as is required, much harder; for in all work of this kind it is expected to appear as fmooth and firm as ftone.

For cornices, the certain quantity fhould be one gauge of plafter, and four of lime; of fand three to one of the whole; the lime, fand, and hair firft made; the plafter to be applied juft before it be laid on; and the fame for the boffings of cielings, &c.

Plaftering is a moft ufeful invention, and has greatly the preference of wood, for cornices, &c. on account of its unity with walls and cielings; but we fee it often lofe its effect, when mixed with wood, as in bafe mouldings, &c.

The intent of appropriating caft mouldings of plafter with wood, is to load a room with a profufion of ornaments, and at little more expence than if done with wood plain; but things of this kind will not bear examining; and for my own part, I think every ingenious man

man would rather approve of half the quantity of ornaments well executed in wood, suitable to, and of a piece with the rest. Belexion mouldings, well executed in plaster, have a noble effect in halls, stair-cases, &c. and are much preferable to any thing of the same value, that can be invented. These, with some well-disposed ornaments, &c. in them, would, in my opinion, be the greatest beauty in the present mode of finishing many capital rooms.

To the immortal credit of the present age, it may be affirmed, that this branch of business is in its full meridian of lustre, both with respect to symmetry and composition; and it may justly be said, that the ancients were in no wise comparable with the present age for their taste in ornaments; on which head the Messrs. *Adam* deserve particular honour; being themselves the originals of many capital designs, which almost beggar description; from the spring of which the whole mass of surveyors, and petty mixturers, have found matter to supply their own want of genius and invention.

It is much to be lamented, that these great men should mistake their path in some respects relative to the propriety of their cornices; which greatly lose their force for want of a little more projection: that symmetry, and happy arrangement which we frequently lose by the distance, would be quite perspicuous, were but a little more added to the above

particular. I almoſt wonder that ſuch excellent judges of beauty never found the ill effects of this deficiency; but whether they have or not, it is beyond a doubt, that their works in general are the moſt capital of the age.

Of the Value of Ornaments.

The value of ornament-plaſtering cannot well be aſcertained without a ſight of the drawings; or rather of the cielings, &c. when finiſhed. However, as far as it may be ſerviceable to the learner in eſtimating a jobb, I will endeavour here to aſcertain them.

And firſt, the reader is to obſerve, that all ornaments on cielings are valued by the foot; and it may not be amiſs likewiſe to note, that if the cieling be lightly enriched with foliage of ſmall relief, intermixed with mouldings of various figures, it may be valued all together by the foot ſuperficial; the dimenſions being taken from the outward ſquare of all, at 3s. per foot. But this is an uncertain way, and cannot be uſed by any but thoſe who are judges at ſight. The only real method therefore is to value all the different works ſeparate, as before obſerved in the meaſurement; and theſe are, or may be done at the following prices:

	£.	s.	d.
Plain mouldings in cielings, at per foot run — —	0	0	$2\frac{1}{2}$
Inferior enriched mouldings to ditto, caſt — —	0	0	3
Superior enriched, caſt	0	0	4

Ditto

	£.	s.	d.
Ditto run upon the cieling, with various enrichment, from 7*d.* to	0	1	2
Foliage, at per foot ſuperficial, from 2*s.* to ——	0	3	6
Large pieces of ornament in the middle of a cieling, at per foot ſuperficial — —	0	4	0
Trophies, caſes of arrows, &c. per. foot ſuperficial ——	0	5	0
Figures, deities, &c. per piece, from 1*l.* to ——	20	0	0
Gollocci and frets, at per foot ſuperficial, 6 inches wide	0	2	0
Ribbons and roſes ſuperficial, at	0	1	6
Large ornaments of feſtoons and flowers — —	0	3	9
Small frets, at per foot run, from 6*d.* to — —	0	1	0

The reader muſt be content, in ornament cielings, to know the real value of the works I have mentioned, as it would be of little validity to prove aſſertions which he does not ſee, or may be unacquainted with; therefore to make it advantageous to him, it will be highly requiſite to ſtudy this matter further himſelf.

Of the Value of Plaſter Cornices.

In the value of Plaſter-cornices it may not be amiſs, firſt, to enquire into the quantity of materials, for a better proof of what I

propoſe to advance relative to the price allowed by ſurveyors, and what is alſo charged by maſters.

And firſt, of full enriched Corinthian cornices, which conſiſt of various ornaments, carvings, &c. and ſhould be all made of the beſt plaſter, which is little leſs than one penny per pound.

The neareſt general calculation that can be made of plain cornices, on account of their number of variations, is, to every foot of plain cornice, the materals, making, &c. ſtand the maſter in 4*d.*—To a full enriched cornice, modillions, &c. 1*s.*—The labour to a foot of Corinthian cornice, as I have made the following calculations from whole rooms, with the labourer's time, laths, nails, ſtuff, lime, and plaſterer's time, are as follow:

	S.	*d.*
To labour — —	0	9
Stuff — —	1	9
It cannot be amiſs therefore to allow the intrinſick value per foot ſuperficial to be — —	2	0
Some ſurveyors are pleaſed to allow	1	6
Others vouchſafe to give —	2	2
Some I have known generous enough to offer a good plaſterer per foot ſuperficial — —	1	2
Some of the capital maſters in town, for fully enriched cornices of the Corinthian or Compoſite order, allow from 2*s.* 8*d.* to —	3	0

Ionick

	S.	d.
Ionick cornices, fully enriched, are worth — —	1	9
All plain cornices are worth to a master, per foot superficial, to find scaffolding	1	2
Though they are done so low as	0	8
Dorick friezes, with ox-heads and proper enrichments, may be estimated per foot superficial, at —	4	6
Cornices to ditto, with mutules and bells	1	9
Surveyors 4*s*. and —	1	10
Enriched friezes, from 1*s*. per foot, to	5	0
Cast friezes, with foliage of 4 inches, measured in the cornices, at 1*s*. 6*d*. per foot — —	1	6
Belexion mouldings enriched, at per foot run — —	0	4
Corinthian and Composite capitals, per foot superficial —	5	0
Chimney-pieces, at per foot superficial	2	0
Ionick capitals in plaster, per foot superficial — —	4	6
Surveyors allow, in some cases	5	0
Terms to chimney-pieces, per foot superficial — —	2	6
Friezes to ditto enriched —	3	6

Of Plain-cielings, Walls, Stucco, &c.

The quantity of materials either to cielings or walls ever varies, because it depends in a great measure on the conduct of the carpenters, bricklayers, &c. The following is the nearest general calculation for every three-coat cieling, or lathed walls :

We

	S.	d.
We muſt allow 5*d*. for materials, ſuch as laths, nails, lime, plaſter, ſand, &c. for labour, if the maſter find ſcaffolding, 6*d*. more, which brings the intrinſick value per yard to	0	10
Every cieling therefore well floated, &c. is worth — —	1	2
Maſters charge the above price		
Surveyors from 9*d*. to —	1	2
Inſide work upon laths, ſuch as walls, &c. — —	1	0
Walls floated for paper, &c.	0	8
Stucco, per yard, well finiſhed on laths	1	9
The materials to a yard of ſtucco, are worth, upon laths	0	10
Walls floated and finiſhed with ſtucco	1	6
The materials are worth per yard	0	$7\frac{1}{2}$
Note, maſters charge for finiſhing upon laths — —	2	2
Upon walls — —	1	10
Surveyors allow from 1*s*. 2*d*. upon laths to — —	2	0
Upon walls, from 1*s*. to —	1	7

	£.	s.
Gray plaſter floors are worth per ſquare, if 2 inches and an half thick	2	14
Surveyors allow from 2*l*. 2*s*. to	2	10
Red ditto are worth per ſquare	3	8
Surveyors allow from 2*l*. 18*s*. to	3	5

The learner is to obſerve in laying plaſter-floors, to put a margin of wood round the room,

room, which must be taken up as soon as it is set, to give room for swelling; for if plaster of such a thickness be laid and confined, it will rise in blisters before it is half dry, and render it totally useless.

	S.	d.
Plaster-framing, as ovolo and flat per foot	0	6
Ditto circular soffits, measure and half		
Framed and raised pannel in plaster	0	9
For white-washing with whiting-size, work, and materials, per yard	0	2
Ditto whiting of new work, per ditto	0	1½

LECTURE XVIII.

OF PAINTERS WORK.

HOUSE-Painting is a branch so common that it needs no comment; I shall not therefore take up my reader's time beyond what is necessary, to enquire into its value. And, first, of the colours of paint that is, or in some cases may be used in a building; which are as follow:

Wainscot colour
Stone ditto
Lead
Pearl
White
Dead white, or flatting
Chocolate
Mahogany
Cedar
Walnut-tree
Pea
Fine sky-blue
Mixed with Prussian blue
Orange
Lemon
Pink

Blossom

Bloſſom colour	Brown
Fine deep green	Yellow
Black	

The preceding are all the colours that can be requiſite for painting either houſes, ſhops, &c. Theſe colours differ ſomewhat both with reſpect to price and quality; therefore muſt have a ſtipulation acording to their value and quantity, in point of execution; as it is certain ſome colours will paint conſiderably more than others, which I ſhall endeavour to ſhew.

Firſt, of the Price of Colours.

	£.	s.	d.
Firſt primer ground in oil is ſold at per hundred —	1	16	0
Or per pound — —	0	0	4
Second primer at ditto	1	16	0
Beſt white-lead ground in oil, at per pound —	0	0	4
Pearl, lead, cream, ſtone, wainſcot, at per pound —	0	0	4½
Chocolate, mahogany, cedar, walnut-tree, ground in oil, at per pound — —	0	0	6
Sky-blue, orange, lemon, pink, bloſſom, ſtraw, Pruſſian blue, from 8*d.* to —	0	1	0
Fine deep green, per pound	0	2	6
Black, brown, yellow, per pound	0	0	4

The

The reader is to obſerve, that all houſe-painting muſt at leaſt be done three times over, ſometimes four; the cauſe of which I ſhall mention hereafter.

Of the Quantity which one Pound of Paint will do over.

	Sq. yds.
Firſt primer ground in, or made thin with oil, will paint, when properly mixed, 18 ſquare yds.	18
Second primer muſt be mixed ſtronger, 1 pound mixed with oil, will paint 10 ſquare yards	10
The beſt white-lead, ground in oil, and properly mixed for the finiſhing, will paint 8 yards	8

Thus if we add the three quantities together, and divide by 3, we ſhall find that one pound of paint properly mixed will prime and finiſh 12 ſquare yards, as in the margin.	3	36 36 — 0	12

We have only to add therefore the oil for mixing, and the putty, and we ſhall find the real value to a yard of painting; which once got, we ſhall proceed to the labour, to ſolve the whole.

Suppoſing then that to one pound of paint to be appropriated for painting to its extent, at three ſeparate times, viz. for the firſt primer, ſecond ditto, and finiſhing, we allow three half-pints of oil, which is more than neceſſary, and one pound of putty for ſtopping, &c. add theſe to the value of the paint,

for

for 12 yards, and we shall easily come at the value of the whole materials, viz.

	S.	d.
To one pound of paint —	0	4
Ditto of putty — —	0	4
Three half-pints of oil, at 1*s.* per quart	0	9
	1	5

The above being added together, as in the margin, we find the charge of materials for 12 square yards is 1*s.* 5*d.* which is somewhat less than $1\frac{1}{2}$*d.* per yard.

And next of the Labour to a Yard of Painting.

The nearest calculation of the labour to a yard of painting, is as follows: — A man who will work any thing smart will do

	Yards.
First primer per day —	70
Second ditto, and stop with putty —	30
And finish about —	40

If we add therefore the three numbers together, and divide by 3, as before, we shall have the exact quantity that a man will begin and finish in one day, which as in the margin is 46.

3 | 140 | 46
12
——
20
18
——
2
——

A

A journeyman's wages in this business are 3*s.* per day; thus if we divide 46 yards by 36 pence, (the journeyman's wages) we shall find, that a master has every yard of painting, three times over, done for less than 1*d.* to which if we add $1\frac{1}{2}d.$ materials, the intrinsick value of a yard of painting is $2\frac{1}{2}d.$ for which masters charge from 6*d.* to 8*d.*

I am far from insinuating, that any master should lower the customary prices; but yet cannot help observing, that I think it a great error in surveyors to allow a business like a painter's, which neither requires thought nor speculation, such extravagant profits; and joiners, in many respects, not sufficient to pay their men half adequately to their merit.

Surveyors allow for out or inside-work, three times in oil, from 6*d.* to 7*d.* per yard. The profit of every yard, allowing for difficult jobbs, is 3*d.* A man for a continuance, painting 40 yards per day, or supposing 30, or even 20, a master must clear by every such journeyman, at these prices, 5*s.* per day. Many masters employ 20 men; the profits therefore arising from them are obvious to every one.

		S.	*d.*
The real price of painting three times in oil should be	—	0	$4\frac{1}{2}$
When clear-coaled	—	0	$5\frac{1}{2}$
Flatting with turpentine	—	0	$6\frac{1}{2}$
Flatting with nut-oil	—	0	$7\frac{1}{2}$

Some

Some of my readers may not know what either clear-coaling or flatting is; I ſhall endeavour therefore to inform them, as well as of their uſe.

Clear-coaling is a body of colour ground in, or mixed with ſize, and done after the ſecond primer, in order to give ſtrength to the colours, and make them ſtand the ſemblance they are meant to do. But I cannot recommend it; for damp weather will affect it; and if the colour intended be white, or at all light, it will always turn yellow.

This compoſition, or what is called clear-coal, is a great enemy to joiners; for let them finiſh their work ever ſo clean, if the men be not very careful, clear-coaling ſpoils it all, eſpecially the mitres, &c.

Flatting is done with a mixture of oil of turpentine, or nut-oil. Its intent is to ſecure the colour, and it is uſed for finiſhing; and when done, leaves the paint quite dead, without gloſs. This is of great conſequence to thoſe who like to have their rooms continue white, as nothing elſe can be appropriated to ſtand the weather.

All common colours are done at the foregoing prices, and allowed as ſuch by ſurveyors: blues, greens, bloſſom, pink, orange, ſtraw, olive, pea-colour, ſhould be 1*s.* per yard, at which they are allowed by ſurveyors.

There is nothing like this difference in the quality of materials or labour, to augment the prices 6*d.* per yard; but when theſe co-

lours are used, it is generally for little abstracted jobbs, which should be paid for according to the time and trouble.

	S.	d.
Sash-frames are allowed, per piece, at	1	4
Might be done for —	1	0
Sashes allowed per square	0	1½
Window lights from 2*d*. to	0	5
Inside-painting, twice upon old work, per yard — —	0	4
Modillion-cornices, per foot run, from 4*d*. to — —	0	9
Plain outside-cornices, per foot run	3	0
Frontispieces, per foot superficial	0	2
Chimney-pieces, per foot superficial	0	2
Hand-rail, banisters, strings, newels, &c. per yard — —	0	10
Hand-rails alone per foot run	0	2
Horse plain cornices, per foot run	0	1
All torus skirting in halls, garrets, &c. per foot run — —	0	1½
Skirting up stairs, per foot run	0	2

LECTURE XIX.

OF GLASIERS WORK.

GLASING is a branch of the least difficulty of any in a building, therefore is judiciously enough joined to the painter, because neither require the executive part of men of merit.

The value of glasiers work is as follows:

	s.	d.
Crown-glaſs meaſured neat for ſaſhes, according to the ſize of the ſquares, per foot ſuperficial —	0	$11\frac{1}{2}$
Saſhes glaſed with London crown-glaſs, puttied on both ſides, as is requiſite, per foot ſuperficial —	1	$2\frac{1}{2}$
Saſhes glaſed with Briſtol crown-glaſs	1	$1\frac{1}{2}$
Ditto, with Newcaſtle glaſs	0	$10\frac{1}{2}$
Ditto, waved or jealous glaſs, per foot ſuperficial — —	2	3
Ditto, plate-glaſs, according to their ſize, from 1 foot to 2 foot panes from 5*s.* to — —	6	0
Ditto from 2 to 3 and 4 foot panes ſuperficial, are from 6*s.* per foot to	8	0
Glaſing with crown glaſs, ſquares in lead-work, per foot —	11	0
Ditto the materials to a foot of this work are worth —	8	0
Taking down leaded windows, ſcowering, ſoldering, banding, and putting in again, per foot ſuperficial —	3	0

Note, 25*lb.* of window-lead are ſufficient for 100 feet ſuperficial, when worked.—— Note alſo, that lights and circular ſaſhes muſt be valued as ſquare, on account of the trouble; and to glaſiers, in ſome caſes, meaſure and half.

LEC-

LECTURE XX.

OF SLATERS WORK.

SLATERS work differs but little in practice (excepting the preparation of the ſlates) from tiling; its greateſt beauty is in the regular appropriating the different gauges; ſo that they appear in bond, and arrangement equally ſtraight. There is ſome difficulty in fitting a valley; but the great principle is the exact form of ſetting the firſt courſe, or raiſing it behind, not to exceſs, but to a certain pitch, ſo that all the ſucceeding ones ſhall appear cloſe, and not to be defective in reſpect to the inner parts for pointing.

There are many ſorts of ſlate in uſe, viz. what is called Can-quarry, Taviſtock ſcantle, and Weſtmoreland ditto, and ſome others, though not frequently uſed. The latter is much the beſt, being by much the largeſt, but ſhould not be appropriated except for very large buildings; or at leaſt, ſuch as are of ſufficient ſtrength for their weight.

	£.	s.
The price of doing theſe per ſquare is, from 2*l.* 13*s.* to —	3	0
Taviſtock ſcantle is ſomething leſs; and rather inferior in quality; and according as they are in goodneſs is done from 2*l.* to —	2	10
Can-quarry are the worſt, and moſtly uſed, the price from 1*l.* 16*s.* to	2	8

 Ditto

	£.	s.
Ditto for temples and ſcheme roofs	2	12
Ditto, ſlates, new ripped and laid	1	1

Among the new buildings there is a worſe ſlate than any of thoſe here mentioned, called Welch ſlate, which is done per ſquare from 1*l.* 8*s.* to 1*l.* 13*s.*

LECTURE XXI.

OF CARVERS WORK.

THIS beautiful and ingenious branch is ſubject to the ſame effect as ornament-plaſter, with reſpect to its value; no ſettled or ſtipulated price can be fixed on a matter of ſuch mutable compoſitions, which conſtantly varies with every freſh deſign.—However, I ſhall give ſome few hints to the learner. And firſt, with reſpect to carving on mouldings for all ſorts of framing:

	S.	*d.*
Ovolo to deal-framing, carved with eggs and tongues, per foot running meaſure — —	0	4
Ditto on mahogany or wainſcot	0	6
O-gee framing in deal, carved with ſeven-leaved graſs —	0	4
On Mahogany and wainſcot	0	6
Small o-gee to framing on deal, three-leaved graſs — —	0	$2\frac{1}{2}$
Large ovolos to doors, with ribbons and roſes, or eggs and darts, per foot run — —	0	8

Large

	S.	*d.*
Large quirked o-gees, with various carvings — —	0	7
Small astragal mouldings to doors, per foot lineal — —	0	3
Small fluting to facios, per foot lineal	0	5
Two inches long —	0	6
Friezes, fluting, 6 inches wide and upwards, at per foot superficial	1	6
Fluting the raisings upon the pannels of mahogany doors, at per foot run	0	8
Carving Corinthian capitals, per foot superficial — —	9	0
Ionick ditto — —	6	0
Composite ditto — —	9	0
Ornaments in alto-relievo, to friezes well executed, from 5*s.* per foot superficial to — —	10	6
Ornaments to friezes in basso-relievo, from 3*s.* per foot superficial to	7	6
Festoons, per foot superfi. from 4s. to	8	0
Figures are all valued at per piece		

As carvers find no materials, and have no advantages but what result from their labour, I shall not pretend to say any thing with respect to the time of execution, seeing it is a business, well known to be upon as eligible a footing, with respect to profits, as any in the building branch. The above prices are such as are allowed by many surveyors.

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LECTURE XXII.

OF THE CONSTRUCTION OF DADO.

DADO is the die or entire part of an order, between the baſe and cornice of the pedeſtal; and by architects is attributed to that plain part of a room between the baſe and ſur-baſe mouldings. This ſort of work, in large rooms, ſhould never be made of thinner ſtuff than what is called whole-deal.

The chief thing to be conſidered in the practice of dado is, the manner of putting it up, which requires ſome thought in order to ſecure it from caſting; the method of keying only being found inſufficient, without a proper manner of placing the keys. There are

a great many ways of doing this: but the beſt, in my opinion, is as follows, viz. when you key your dado, leave the keys long enough at the broad end to reach the joiſts, or floor; and put the broad ends of them downwards, for this reaſon; that there is a proclivity, or tending downwards in all work, which can never be detrimental to dado thus done; for if the key goes to the floor, there it ſtops; and if it ſhould ſhrink, the proclivity of the dado will ever keep the work ſtraight. If the broad ends were upwards, the dado might drop from the keys, and render them of no uſe. In putting dado round windows, mind to keep up the front of the elbow a little, that after the mouldings are on, and capped, the ſhutters may open eaſy.

Dado in all angles muſt be grooved, and well nailed; obſerve alſo, that no nails be put in the bottom-edge of dado; let it receive no faſtening but what it has from the keys; if it be confined both at the top and bottom, it is ſure to break.

Obſerve, of dado for circular rooms, that you do not adopt the wretched methods of contract-mongers, and taſk-maſters, of gluing your dado up and down; the right method of gluing circular dado, is to make a ſaddle to the ſweep of your wall; if it be a large ſweep you may make a fineer half an inch thick, and bind it upon the cylinder or ſaddle; after glue backings to the ſweep behind:

 leave

leave it a few days to dry, and ſtrike your work for putting up.

There is a method uſed by many of grooving dado, for circular pats on the back, at one, two, or three inches apart after, bending it to the ſaddle, and then glue it in pieces to the grooves, which, if well done, will anſwer the purpoſe; ſome people ſaw a number of ſaw-carfs into the back, and bend it to the ſaddle as before; after which they glue it in tongues or fillets into the grooves made by the ſaw, and then ſtrike it for putting up. But for good ſound work the former method deſerves the preference.

With regard to long lengths of dado, be careful in breaking the heading-joints, and do not, like the taſk-maſters, make a heading-joint quite through.

As to the height of dado, the window is to be the guide; leaving the ſame margin when the capping is on, as there is from the ſhutter to the bead; when there are backs and elbows, the dado may be put up at pleaſure, or to the fancy of the builder. Some architects propoſe a fifth part of the height of the room; but this will not ſuit very low, nor very high rooms. I think dado ſhould never be higher than 3 feet 9 inches, nor lower than 2 feet 6 inches. If rooms were all about twelve feet high, a fifth part would do very well; and ſo on to a room of 15 feet high; when they run above this pitch, for every 6 inches in the room's height, I would add

add one inch more to the height of the dado. If there be columns or pilasters, the dado should in every respect be subservient to the pedestal of the order.

	S.	d.
The price of this work, charged by masters, is, per yard, with materials, from 4*s.* 6*d.* to —	5	6
Surveyors allow for dado of whole-deal, per yard —	4	6
Inch and half ditto —	5	0
Of inch ditto, per yard —	4	0

The real value of dado is as follows:

The stuff to dado, allowing waste, should be to a master per foot 2½*d.* nine feet of which is —	1	10
Glue and nails to ditto and keys, per yard — —	0	4
Labour to ditto, per yard	0	10
	3	0

Some people will wonder how I can fix 10*d.* per yard for labour; I beg such to understand, that this is the neat price a master pays out of his pocket for such work, as proved by the following example:

A journeyman of 17*s.* or 18*s.* per week will glue up six twelve-feet lengths per day, plane them the second, and put them up the third, with casual breaks, &c. We find therefore that two lengths are one day's work to begin and

and finish; which two lengths, when put up, may be six yards; and which, allowing the master 3*s*. per day for his man, is but 6*d*. the other 4*d*. per yard I allow for keying ditto, which makes in all 10*d*.

	S.	*d*.
The universal price therefore of dado of inch and half deal, is —	5	0
Whole-deal should be per yard	4	6
Inch ditto — —	4	2

Circular dado is double measure, and paid extra for the saddle or cylinder which it is glued upon.

LECTURE XXIII.

OF MOULDINGS IN GENERAL.

THE guide and master-piece of all architecture depends solely on the magnitude and composition of mouldings; these are the leading touches of art, which give force and beauty to whatever is intended; every thing, of whatever sort or nature, takes its semblance, or changes its effect, from the power that is contained in these governing principles: how cautious, therefore, should every artist be in the designing or composing of mouldings, since that on those alone depends that splendid ease, required to attract the beholder's eye, and enliven the form of imitative nature.

The

The great and most sensible difference between ancient and modern architecture, is wholly comprised in the composition of mouldings. Notwithstanding so great and distinguishing an article to the beauty of all work, as mouldings are, we daily see such productions of this sort, that one would almost be persuaded to think that there was no cause for them but custom, nor any properties belonging to them but the form, which might be extended or contracted as ideas or fancy might guide the pen of the artist; and, I believe, there are many that consider themselves as adepts in architecture, who vary but little from the above observation.

Those gentlemen who satisfy themselves with opinions of this sort, are as far from the comprehension of symmetry, and real effects, as the difference between right and wrong. I own, there is a thirst for variety peculiar to the English nation, which must be satisfied, or the works of art (like the continued form of a worn-out fashion) would quickly decline, and be disgustful: it is highly necessary therefore to strive at invention, to gratify the mutable taste of such a people. But even this should be done within the rule of propriety; for excesses in any art are disgusting.

The invention of many new members of mouldings were well concerted and introduced, by the original authors of them; but they are now prostituted to such a pitch of extravagance, that I almost wonder the inventors do

do not leave this by-road, (which they firſt ventured upon, and made familiar and ſmooth, to their laſting praiſe) and find out ſome other ſimilar path, in which they may move on, for a time, without let or moleſtation.

The field of nature will never be exhauſted, nor propriety loſe its power of guidance; whatever therefore bears a reſemblance of the former, within the circumſcription of the latter, is conſiſtent with ſymmetry, and hath the advantage of ſound reaſon to fortify the invention. Any thing eſtranged from the above, deviates from the real ſenſe of all mouldings; which are intended to give force and elegance to works, wherever applied.

The preſent taſte of mouldings (as introduced by numbers) differs much from this; for, inſtead of giving force and beauty, they in many caſes diminiſh the natural grandeur, for want of proper dimenſions.

Any moulding, of whatever ſort or nature, above the eye, ſhould have a projection, that the whole effect of the different members may be plainly diſcovered, otherwiſe they ſerve to no purpoſe. It will be of little uſe to load a cornice with beads, and other ſimilar quirked mouldings, if they loſe their effect by the diſtance. I muſt allow, neverthelefs, that mouldings deſigned in the above manner in many caſes are pleaſing, but they muſt be judiciouſly appropriated; for the learner is to underſtand, that inſtead of leſs, thoſe mouldings require more projection than others; the queſtion

queſtion not being how thoſe things will or do appear cloſe to the eye, but we muſt conſider the diſtance at which they are to be viewed; with the altitude, and natural point of ſight. If theſe circumſtances were maturely conſidered, I believe we ſhould find, that cornices of all ſorts ought not to conſiſt of any one of the above particulars:—architraves to doors, windows, &c. as well as baſe and ſur-baſe mouldings, doors, window-ſhutters, belexion and other mouldings cloſe to the eye, may have theſe introductions:—cornices to rooms of all ſorts ſhould be free; but if they muſt be ſubjected in other reſpects to the taſte of the times, the learner is to obſerve, never to exceed the following bounds, viz. To make the cornice leſs than 1-24th part of the height of the room, nor to project leſs than two thirds of its height: and if the mouldings laid down by ſome eminent architects be not ſufficient for his taſte, I muſt leave him in other reſpects to his own fancy; with this point in view, not to out-ſtretch the modeſty of the above proportions.

Of the Practice of Mouldings.

The working, or rather the taking-off mouldings from drawings, is a matter of ſome conſequence to learners; I ſhall not ſpare therefore to be as plain and particular as poſſible, to render this familiar to the weakeſt capacity: but muſt obſerve to the ſtudent, if he be a ſtranger to this matter, that it will be

be requisite to proceed step by step by the following example, (as descriptions in writing are sometimes troublesome to remember) and then in this, as well as all other points of practice, he will be assured of success.

Example of taking off Mouldings.

Before you begin, draw a line close to the face of the moulding (not interfering with any of the fillets) next from this face-line draw another line square at the extreme top and bottom of the moulding, which will give the width of your stuff to be planed up; from the face-line draw a line parallel, for the thickness of the stuff; next continue all the lines of the drawing into this first face-line; and at the projection of each annulet, or fillet, let fall perpendiculars into the face-line too, which will shew the wood to be taken out for working your squares; the same for springing both at top and bottom. Having done this, strike a line across your piece of wood, and with your dividers begin either at the top or bottom of the drawing, and take off these several marks of intersection, pricking them upon the piece of stuff for the moulding; as likewise the springing both at top and bottom; then set your gauges to the several pricks, and run them all along the piece; proceed afterwards to work it, first taking off the springing, and set it upon the same position for working, which it must be in when put up; by these means you will sink all your

ſquares level. If there be an ogee in the drawing, obſerve with your dividers to draw the curve of the hollow into the face-line, the ſame as the fillets, which will be your place for pricking off upon your ſtuff, and the extent of the hollow; thus if your round be well fitted, and worked exactly to the line, your kindred hollow will work the round to an interſection of the greateſt nicety.

There is no other moulding, but this, that requires any obſervation in the taking or pricking off. O-gees and faint hollows are the only difficult mouldings; with reſpect to the latter, whenever they occur, it is always upon a plane face, as architraves, &c. in which caſe, you muſt always leave a fillet at the bottom of the hollow, and rabbit the architrave, or other plane where it is to be applied, becauſe it would be impoſſible to work a moulding of this ſort to an edge with any accuracy.

Of the Value of Mouldings.

	s.	*d.*
Maſters charge for all ſtraight mouldings, as baſe and ſur-baſe, plain cornices, &c. with materials, per foot ſuperficial, from 1*s.* 2*d.* to	1	6
Surveyors allow in general —	1	2
Dentel cornices by maſters —	1	8
Surveyors — —	1	5
Block or modillion cornices, per foot, maſters — —	1	8

Surveyors

	S.	d.
Surveyors in many places —	1	4
Blocks and modillions at per piece, according to their size, from $1\frac{1}{2}d.$ to — —	0	6
Small block cornices are valued all together, at — — —	1	9
Dorick entablatures all together; with mutules triglyphs, &c. at per foot superficial, masters	2	6
Surveyors from 2*s.* 2*d.* to —	2	4
But these are usually valued singly, the cornice at 1*s.* 2*d.* the triglyphs and mutules at per piece, which answers the same purport.		
Architraves, at per foot superficial, by masters — —	1	0
Surveyors, from 8*d.* to —	1	0

The universal price of mouldings is as follows. To every superficial foot of moulding may be reckoned, in general, $\frac{3}{4}$ of a foot of stuff. In some cases it will require more, and others less, which, of good whole deal, as none else should be used for mouldings, we will call

	S.	d.
used for mouldings, we will call	0	3
Brads, glue, &c. —	0	$1\frac{1}{2}$
The whole materials to a foot superficial, are —	0	$4\frac{1}{2}$

The labour to all mouldings worked by hand (as the others are not worth notice) stands

 a master

		S.	d.
a master in near 4*d*. per foot, which makes the labour and materials per foot	— —	0	$8\frac{1}{2}$
The universal price therefore of all straight mouldings should be per foot superficial	— —	1	0

To prove the labour, 4 lengths of 10 or 12 feet, in two-membered mouldings, are one day's work, which may girt about three inches each, and make twelve feet in the whole, which, at 4*d*. per foot is 4*s*. above a journeyman's wages.

Circular mouldings are very badly regulated, having no more than double measure, which is in every case too little, both for materials and labour. The real value of circular work should be at least trebled; and, in many cases, double measure, and double price.

Architraves, double-faced, to masters should be the same as mouldings, both stuff and labour having the same proportions.

Single faced architraves are made of thinner stuff, with a moulding glued upon them; the materials are not worth more than 2*d*. per foot; the labour to ditto, 2*d*. more; the real value therefore should be to masters, per foot

	S.	d.
should be to masters, per foot	0	$6\frac{1}{2}$
Many masters charge for this work	0	8
Surveyors allow from 5*d*. to	0	8

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LECTURE XXIV.

OF DOORS.

THE nature of a door is too obvious to need a comment; I ſhall immediately proceed therefore to relate what is neceſſary to be obſerved in the practice of them.

Moſt kinds of doors ſhould be put into the hands of the beſt workmen, for they are a part which require great execution; being always in uſe, they ſhould be made particularly ſound, firm, and well handled, becauſe they are ever oppoſed to the eye; the great principle of chief merit lies in the ploughing, and ſticking the moulding upon the frame; for without maſterly performance in theſe two points, all the care taken in planing the ſtuff, mortiſing, tenoning, &c. will be of little uſe; becauſe in thoſe two parts lie the great efforts to a well executed door. There are different ways of putting a door together, but the beſt and ſureſt is done after the following example.

When you have planed up your ſtuff, and mortiſed the ſtiles and rails all the width, proceed to ploughing and ſticking, and cut out what is called the haunching after; the method adopted by numbers, of haunching the ſtiles and rails before you plough or ſtick them, is a latent notion, invented by ſome who were fonder of ſtudied maxims, than well-approved methods; if the principal ef-

fort to a clean door, lay in the mortiſe, and tenon, the maxim would be good; but as it depends ſolely upon the parts before mentioned, it is obvious, that our particular care ſhould be to theſe principles; which cannot ſo well be done to a certainty with the haunching cut out firſt; beſides the inconvenience of ſpoiling the plane, by knocking the end againſt the notches. There are others who pretend to be more ſure and wiſe than the laſt mentioned, that put their work together ſquare, and plane it off on both ſides; then proceed to plough and ſtick, &c. but theſe are more intolerable than the other; having not one argment to ſupport it; for if the ſtuff be reduced irregularly (which muſt be the caſe when thus done) the moulding muſt conſequently be ſo on one ſide, and palpably void both of truth and beauty.

There is another obſervation in ſcribing, which it may not be amiſs to mention, which is the common error many young men daily commit for want of thought, the attempt of ſcribing a ſquare or the level fillet of an ovlo on doors, or other framing of this kind: I would beg of thoſe who follow this method, to aboliſh it, and conſider the inconſiſtency of mitring two level pieces of equal thickneſs, and to lap one upon the other with a ſcribe.

As all framing is founded upon theſe principles, it is unneceſſary to ſay more of the practice of common work; though it may be requiſite to ſay ſome little of bead and fluſh; after

after which I ſhall proceed to the value of doors, with ſome remarks touching mahogany and wainſcot ones.

A bead is a moulding which cannot be otherwiſe framed than by a mitre; hath therefore a limit or certain extenſion, for every rail or muntin; and is not like work that is ſcribed together, which may be moved to any length within the circumſcription of the eye.

The beſt method of framing bead and fluſh for learners, is, to mitre work ſquare, in this ſtate to put in the pannels, and afterwards ſmooth all off together; then take it ſeparate, and ſtick the bead; if the pannels be marked, and put to their places, and the bead well ſtuck, you may be aſſured of making clean work.

Of Mahogany Doors.

Mahogany and wainſcot doors differ from common deal framing on account of the nicety of the mortiſes and tenons; which require great care, no pins being uſed in theſe ſorts of work, which ſhould therefore be made as ſmooth as if the whole were executed by a plane. The manner of putting it together is the ſame in every reſpect beſide as other framing; except the double margin in the middle, which muſt always go through the top and bottom rail; the top and bottom rail muſt alſo be continued, and inſtead of being mortiſed, that part where the mortiſe ſhould be, muſt be left as a tenon; and the double-

margined ſtile mortiſed in this place, and ſlipped on, both at the top and bottom.

The true meaning of this method is more forcibly to ſhow the effect of folding-doors, which could by no means be done, if this double-margined ſtile were to be tenoned into the top and bottom rail; and the bead run acroſs the grain of the wood.

A mahogany door well executed, is perhaps, one of the neateſt pieces of workmanſhip that comes into the hands of joiners. There are many ſorts of them; but I ſpeak of the beſt; ſuch as are worth in the labour only 10*l.* or 12*l.* making; numbers of which are in this metropolis, as well as in many noblemens and gentlemens houſes in the country.

As theſe ſort of doors are unknown in ſome parts of the kingdom, I ſhall take the liberty to deſcribe one of them. The beſt ſort of mahogany doors are caſed, having deal within both ſtiles and pannels; and are made in the following manner: Firſt, upon the edges of the ſtiles and rails, glue ſlips of mahogany, of an inch and a quarter each; round the pannels alſo muſt be put a margin of the ſame, ſomewhat broader than the railing, and neatly mitred at the angles; when they are raiſed and fineered, a ſmall aſtragal-moulding is put upon the top of the raiſing of the pannels. They muſt likewiſe be croſs-banded at both ends, and all the pannels fluted round upon the raiſings; the ſtiles and rails fineered as the pannels:

pannels: the reason of applying the deal, is, for the advantage of fineering; having more attraction than any other wood.

It is almost impossible to fix a price for one of these doors, without inspection, more than the labour; because it chiefly depends upon the value of the fineers; which are from 1*s.* to 10*s.* per foot, and more; we must confine ourselves therefore solely to the labour. A mahogany door, well executed in the above manner, is worth, per foot superficial, to a master, in labour only, 12*l.* 10*s.* 6*d.* and will take a journeyman near nine weeks work; one of those doors with the materials is worth 20*l.*

To the learner, who is not acquainted with the nature of fineering, I must recommend to be particularly careful of his glue; as most of the errors that happen in fineering, are caused by laying on the glue too thin: glue for mahogany fineers should be at least of treble strength to what is commonly used for rubbing of joints; he should also be careful that no water get under the fineer, and that the iron with which the work is heated be not moved to any dry place, but where the glue lodges; keeping still wetting every part where there may be occasion to move it.

There are other mahogany doors, some fineered and others solid, from 2*s.* 6*d.* per foot to the above price.

Mahogany

	S.	*d.*
Mahogany doors ſolid, and flat pannelled, are worth, with the materials, per foot —	2	6
Surveyors allow, according as they are in goodneſs, from 2*s.* to	2	9
Maſters charge —	3	0
Thoſe which are fineered vary according to the price of the materials, &c.		

Wainſcot doors are uſually made with double margins in the middle, raiſed upon the pannel, with an aſtragal moulding, and croſs-banded, as mahogany ones.

	S.	*d.*
Any executed in the above manner are worth, per foot ſuperficial	3	6
Surveyors allow to ditto —	3	6
Maſters ditto — —	4	0
Ditto, with flat pannel, per foot ſuperficial — —	2	3
The materials to a wainſcot door, with raiſed pannel on both ſides, are worth per foot of good Norway oak, glue, &c. —	1	4
Ditto, flat pannelled —	0	10

The labour to a wainſcot door, raiſed pannel, double-margined, croſs-banded, and an aſtragal mitred round the top of the raiſing, is about a fortnight's work; ditto, with flat pannel, 6 days; common doors, ovlo, and flat pannelled on both ſides, are 2¼ days work.

To

	S.	d.
To a master are worth, per foot superficial, with materials	1	4
Some surveyors allow ——	1	6
Masters charge ——	1	6
Ditto, with raised pannels on both sides well done, are worth	1	10
Surveyors allow from 1*s.* 7*d.* to	2	0
Masters charge of good stuff, well done ——	2	0
The labour to one of these doors is four days.		
Bead and flush doors of deal, 2 inch stuff; work on both sides, are worth per foot superficial ——	1	6
Surveyors allow from 1*s.* to	1	6
Many masters charge ——	1	6
For bead and flush, 2 inch stuff of wainscot, work on both sides, surveyors allow from 1*s.* 9*d.* to	2	2
Masters charge ——	2	2
The labour to one of these is 6 days.		
Bead and flush doors, on one side, per foot, are charged by masters, at —— ——	0	10
Surveyors allow from 7*d.* to	0	10
The labour to one of this sort is $1\frac{1}{4}$ day.		
Ditto, ovlo and flat pannel, of whole-deal, work on one side, square back, the masters charge	0	10
Surveyors allow from 8*d.* to	0	10

The

	S.	d.
The materials to whole-deal doors, ovlo and flat pannel, are worth per foot superficial ——	o	$3\frac{1}{2}$
The labour to one of this sort of doors is $1\frac{1}{2}$ day.		
This sort of work, stuck with an o-gee, or any other moulding the same.		
For whole-deal square-framed doors, and flat pannelled, surveyors allow, per foot single measure, from 5*d.* to ——	o	7
Masters charge ——	o	7
The labour to one of these doors is one day's work.		
The materials are worth per foot	o	$2\frac{1}{2}$
The universal price should be per ft.	o	$5\frac{1}{2}$
For whole-deal ledged doors, stuck with a $\frac{7}{8}$ o-gee ploughed and tongued, surveyors allow, per foot superficial, from 8*d.* to	1	0
Masters charge from 10*d.* to	1	1
The materials for one of these doors, of good yellow deal, nails, &c. are worth per foot superficial	o	5

The labour to ditto, $1\frac{3}{4}$ day; which may be about 3*d.* per foot more; the universal price therefore should be per foot $9\frac{1}{2}$*d.*

The learner is to observe, that the ledgings or frame of one of these doors is mortised and tenoned together, and the frame so contracted, when

when nailed on, as to leave a rabbit both on the ſides and the top for a ſtop againſt the door-caſe.

	s.	*d.*
For whole-deal doors, plain, with a bead upon the edges, and battens nailed upon the back, for ware-houſes, &c. ſurveyors allow, per foot of yellow deal, from $5\frac{1}{2}$*d.* to	0	$6\frac{1}{2}$
Maſters charge —	0	7
The materials for one of theſe doors worth, per foot —	0	$3\frac{1}{2}$
The labour 1 day's work. The univerſal price therefore ſhould be, per foot — —	0	$6\frac{1}{2}$
All half-inch batten doors are worth per foot, ſtuff and labour	0	$3\frac{1}{2}$
Some maſters charge —	0	$4\frac{1}{2}$
Surveyors allow from 3*d.* to	0	$4\frac{1}{2}$
For large coach-houſe doors, &c. yellow deal, of $2\frac{1}{2}$ inch ſtuff, bead and fluſh in front, and filled with fluſh behind, or framed ſo, the maſters charge per foot	2	0
Surveyors allow from 1*s.* 6*d.* to	2	0
The materials to this ſort of work are worth, per foot —	0	$7\frac{1}{2}$
The labour to theſe doors is worth, per foot, 10*d.* the univerſal price therefore ſhould be, per foot	1	8

LEC-

LECTURE XXV.

OF FLOORS.

A Floor is the plain area, or superficial content of a room; of these there are divers sorts and qualities, as of Norway oak, clean deal, second best ditto, battens of three sorts, white deals, &c. but the best are of oak.

There is nothing very particular in the practice of floors; though it may not be improper to make two or three observations: the first is, when the workman prepares his boards to be very careful not to shoot the edges too much under: for, if that be done, they are then sure to creak, a thing very disagreeable: the next is, that he be particularly careful, that the joists next the walls be directly straight, and that the boards in those places (when laid) be of an exact thickness, and straight across; for if there be any defects, they are sooner discovered at the ends of the boards than in the middle; besides, there is the disadvantage of their remaining so, because they cannot so well be smoothed off.

The next thing is, when you plough and tongue the ends of the heading-joints to lay that tenoned first; in so doing you will have two-thirds of the board to nail through; whereas if you lay the ploughed one first, you have but one third; besides, you will have the disadvantage of making both your joints with a rabbit-plane, which is troublesome.

The

The next observation is, when you lay a dowel-floor, to be sure to bore for the dowels, and utterly abolish the task-masters method of punching the edges; also, when you mark them, do not be over anxious in giving too much draught to the pins, for by so doing you will not only take away the efficacy and strength, but likewise bruise, and render the heading joint more defective than if it were not close at all. With regard to the number of dowels, if the joists be no more than 10 inches apart, one dowel between every joist will do; if 12 or 13 inches, there must be two, and of oak floors three.

	£.	*s.*
The masters charge for dowel-floors of Norway oak, from inch and eighth to inch and quarter stuff, per square yard, is —	5	10
Surveyors from 4*l.* 10*s.* to —	5	5
The materials, dowels, &c. are worth per square yard, of good Norway oak, inch and quarter stuff	3	3
The labour to a square of wainscot-floor, well done, is six days work; the universal price therefore should be per square —	4	15
For clean deal-floors, clear of sap, the masters charge per square, from 4*l.* 10*s.* to —	7	0
Owing to a particular value they sometimes set on boards of an unusual length, which they get clean to lay through without any heading-joints.		

I   I have

	£.	*s.*
I have known a maſter in London charge for particular boards, per ſquare ——	10	10
The ſtuff unprepared coſt 11*d.* per foot; and the maſter had kept it by him ſeven years, to ſerve a particular occaſion.		
Surveyors allow for clean floors of deal, from 3*l.* 15*s.* to	4	15
The boards and dowels to a ſquare ſhot, clear of ſap, are worth per ſquare ——	3	0
Labour to ditto, 4½ days; the univerſal price therefore ſhould be	4	15
Second beſt ditto, dowelled, maſters charge ——	4	0
Surveyors from 3*l.* to ——	4	0
The materials are worth per ſquare	2	5
Labour, four days; the univerſal price ſhould be per ſquare	3	15
For common ſtraight joint floors, the maſters charge per ſquare ſhot, clear of ſap ——	2	2
Surveyors allow from 1*l.* 15*s.* to	2	0
The materials of ſhot clear of ſap, are worth per ſquare ——	1	10
Labour to ditto, 2½ days; the real value therefore ſhould be per ſquare ——	1	18
For common folding-doors of white deal, the maſters charge from 1*l.* 10*s.* to ——	1	13

Sur-

	£.	s.
Surveyors allow from 1*l.* 5*s.* to	1	13
Good white ſtuff appropriated for floors, is worth per ſquare, whole-deal ——	1	5
The labour to ditto, two days; the univerſal price therefore ſhould be at leaſt ——	1	13

Note, the nails and furrings are included in the materials to all the above prices.

The quantity of nails to all floors is as follows: To folding and ſtraight-joint floors, every ſquare will take 250 nails; dowelled ditto, 130.

LECTURE XXVI.

OF GROUNDS IN GENERAL.

GROUNDS are the level or plane ſurfaces on which all works are fixed, and require but little execution; though it is requiſite all theſe things be noticed in the putting up; becauſe on the juſt and exact form of grounds, depends the conſequence of many material matters; ſuch as the hanging of doors, window-ſhutters, &c. as well as the fixing of architraves, mouldings, &c.

Grounds to doors muſt always be ploughed on the edge, if not mortiſed to receive dado, if any be uſed.

In making grounds to windows, care ſhould be taken that they are not bevilled too much,

left that should be an impediment to the back-shutters; which is very frequently the case.

Grounds to windows should be reduced to $\frac{1}{4}$ of an inch upon the edge, and should not be bevilled more than $\frac{1}{4}$ more, unless the window-shutters be in spacious buildings, and run from 12 to 16 inches wide; in such cases there is no difficulty.

Grounds in general are charged by masters, and allowed by surveyors, per foot, from $2\frac{1}{2}$*d.* to $3\frac{1}{2}$*d.* which is a fair price, if the grounds to windows be included; if not $2\frac{1}{2}$*d.* should be the price. Grounds to windows should be 3*d.* double measure.

	S.	*d.*
All grounds to chimnies are charged, by masters, from 6*d.* per foot superficial, to ——	o	$8\frac{1}{2}$
Surveyors allow from 5*d.* to	o	8
The materials to chimney-grounds, with glue and nails, are worth per foot, 4*d.* labour to ditto, to a master, 4*d.* the real price therefore should be ——	o	8

LECTURE XXVII.

OF WINDOW-SHUTTERS.

THERE is nothing particular in the practice of shutters, more than has already been said of the framing of doors, unless they be made flat pannel, which is the present practice,

practice, with an astragal moulding mitred round, about the distance of the supposed raising: what I mean by difficulty here, is to advise the learner to be careful to secure his pannels, lest they should cast, which will cause some trouble when he comes to put on his mouldings; the best method of doing this is to plough some pieces the thickness of the pannel; and, when you have planned and finished them, put those pieces to the ends, till you have put on the mouldings: this may be done as well after shutters or doors are together; but the other is the cleanest way, as will appear in practice.

Of the hanging of Shutters.

There is some difficulty in the hanging of shutters to learners, I shall endeavour therefore to be as clear as possible in this particular.

If shutters be hung double, that is to say, cut in the middle, they must always be hung the whole length first, and then taken down and cut; observe also with regard to this last particular, that you do not cut the joint by the range of the middle bar, but square from each outward stile, till they both meet in the middle; the reason of this is obvious. If the sash-frames should incline either way, they will not open, if cut otherwise than square.

In order to hang shutters at the first trial, observe the following method: First, set off the margin from the bead on both sides: afterwards prick upon the sash-frame half the

thickneſs of the joint of the hinge; then drive in brads at thoſe pricks; to which put the ſhutter, and ſcrew it to; and when opened, it will exactly turn to the place required.

	s.	*d.*
Window-ſhutters are but very indifferently paid for; the maſters charge per foot for front ſhutters, ovlo and flat pannel, bead and butt on the back — —	1	0
Surveyors allow from 10*d.* to	1	0
The materials to window-ſhutters, ovlo and flat pannel in front, and fluſh bead behind, are worth per foot ſuperficial, with glue, &c.	0	4
The labour to ditto, hung double, to a maſter is worth per foot 9*d.* therefore the price of front-ſhutters ſhould be — —	1	3
Ovlo and flat in front, and ſquare behind, hung ſingle, ſhould be meaſured with the back-flaps and linings; if they be framed, and all reckoned as ſingle work, at per foot ſuperficial, if well done, the charge ſhould be — —	1	0

There is no way either for maſters to be paid for their trouble, or gentlemen to have their work well done, unleſs this way of ſettling the matter be adopted. The method by ſurveyors of meaſuring front ſhutters at value and half, and back-flaps but ſingle meaſure, at

at the price of 10*d.* the former, and 7*d.* the latter, will in no wise pay the labour and half the stuff.

	S.	d.
For supposing a window of 18 feet, the making the shutters, fitting in, and hanging ditto, is at least five days work; which we will call only	13	4
The stuff, glue, &c. considering the disadvantage of cutting to waste, is worth, per foot altogether, $3\frac{1}{2}$*d.* which is ——	4	11
	18	3
I will say, to front shutters 9 feet, at 10*d.* — —	7	6
Back-flaps, nine more, at 7*d.* ditto	5	3
	12	9

We find, by the above observations, that the labour of making and hanging shutters to a window amounts to 18*s.* 4*d.* and that the price allowed by many surveyors is only 12*s.* 9*d.* with materials; I will appeal therefore to every sensible man, if this matter does not require a better stipulation.

Some people may think that five days labour is more than these things will take; and so it is with some men; but we are not, in labour, to judge from the best workmen, but take the casual run in a shop; and if we do

that, I believe we ſhall find, in a window well done, but little variation from the time before mentioned. Taſk-maſters, indeed, would do it in three days; but work ſo done is of little uſe, when compared to, or placed near, ſomething of the ſame kind from a capital ſhop.

The real price of window-ſhutters ſhould be ſettled according to the following example:

	S.	d.
Inch and half ſhutters, ſtuck with o-gee or fancy moulding mitred together, flat pannels with moulding round ditto, fluſh and bead, or ſtuck with an ovlo, &c. ſhould be per foot ſingle meaſure —	2	0
Ditto, raiſed in front on the pannel, with aſtragal moulding upon it	2	3
Ditto, fluted upon the raiſing	3	6
Back ſhutters to ditto, framed bead and fluſh —	1	0
All common window-ſhutters, fronts and back-flaps framed, ſhould be valued all together at per foot ſuperficial, with materials —	1	0
Common ovlo ſhutters, ſquare behind, back-flaps plane, per foot all together — —	0	10

Theſe prices are as low as any maſter, that does reputable work, can afford, to live by.

LEC-

LECTURE XXVIII.

OF WAINSCOTING.

WAINSCOTING, in this refined age, is quite obsolete, and seldom used, except in studies, or offices for servants, &c. I shall omit therefore saying any thing of it more than its value.

	S.	*d.*
For wainscoting with yellow deal, flat pannel, per yard, masters charge from 4*s.* 6*d.* to —	5	0
Surveyors allow from 3*s.* 9*d.* to	4	6
The materials, whole-deal, and ¾ pannels, are worth per yard, glue, nails, putting up, &c. —	2	6
The nett labour to a yard of wainscot is, on the nearest calculation, valued at 1*s.* 2*d.* the universal price therefore should be at least	4	0
For square wainscot, whole white-deal pannels, of ¾ stuff, masters charge from 3*s.* to —	3	6
Surveyors allow from 2*s.* 10*d.* to	3	3
The materials to a yard of white-deal, square wainscoting, are worth	2	0
Nett labour to ditto, 11½*d.* the general price therefore should be per yard — —	3	3
For 2 inch partitions, square, and flat on both sides, masters charge per yard — —	4	6

	S.	d.
Surveyors allow per yard from 4*s.* to	4	6
The materials to a yard of this ſort of work are worth, per ditto, about	2	6
For the labour to ditto, at the neareſt calculation, a maſter muſt pay, is, 1*s.* 6*d.* the univerſal price therefore cannot be leſs than —	4	6
For ſquare wainſcot, framed fluſh for hanging canvas againſt, for paper, &c. the maſters charge —	2	9
Surveyors allow from 2*s.* 4*d.* to	2	8
The materials to a yard of this are worth — —	1	6
Nett labour to ditto 1*s.* the univerſal price therefore of this ſort of work ſhould be — —	2	9

Of Backs and Elbows.

Theſe are a good invention of wainſcoting, appropriated to the backs and elbows of windows, and framed after the manner of the ſhutters, which make not only the windows of one connected form, but alſo give more room, by the advantage of the projection of all the baſe and ſur-baſe mouldings, which ſtop againſt the architraves, and in this caſe go down to the floor, or finiſh upon a ſquare plinth the height of the ſkirting.

This

	S.	d.
This sort of work is but poorly paid for; the price charged by masters is, per foot — —	0	$6\frac{1}{2}$
Surveyors allow from 5*d.* to	0	$6\frac{1}{2}$
The labour to one foot of this work is 3*d.* nett; the materials are worth, per foot, ovlo and flat, $3\frac{1}{2}d.$ the universal price therefore to masters should be $7\frac{1}{2}d.$ or —	0	8

LECTURE XXIX.

OF SASH FRAMES AND SASHES.

SASH-Frames are a part of the business easily understood, and require but little skill in the execution; the principal care should lie in the dividing the pulley-piece, so that there be room for the sashes to move; observe also, that if your sashes are to be hung with iron weights, the pulley-block should be put within three inches of the top; else, if your frame be short, you will not have room, on account of the length of the weights. Observe likewise, with regard to the inside linings, that they be not less in width than $4\frac{1}{2}$ inches. By so doing you will oftentimes prevent a great deal of unnecessary trouble in hanging the back-shutters, and also have sufficient room for bars, &c.

Sashes, well made, require good execution, and should always be put into the hands of

men

men of merit and experience, becauſe they are a part of the branch that is ever oppoſed to the eye, therefore ſhould be made particularly clean; eſpecially that ſort which is ſtuck with an aſtragal and hollow.

There are many particulars to a well-made ſaſh, which the learner muſt be apprized of; firſt, the planing up the ſtuff; ſecondly, the ſetting out; thirdly, the mortiſing; fourthly, the filliſtring, and ſticking the moulding; and, fifthly, the great principle or maſter-ſtroke, which is the wedging up; for on this depends the beauty, or real effect.

The learner is to underſtand that the chief merit of a ſaſh is attributed to the ſtraightneſs of the bars, and ſuperficies, which may be totally diſconcerted by an unneceſſary blow at one ſingle wedge, though the whole work to it beſide be ever ſo well done; great care therefore ſhould be taken of this matter, as well as the forementioned obſervations.

There are many ways of putting an aſtragal ſaſh together; the beſt method is to mitre the whole moulding, not through into the mortiſe, but a little lower than the face of the moulding, on both ſides, to the extreme point at the top.

The rail or bar which is tenoned muſt be mitred, as if for ſcribing; and then cut under with a ſaw, from the point to the tenon. Obſerve, in dowelling ſaſhes, that the dowels be not ſhorter than four inches.

Saſhes

	S.	d.
Sashes and frames are generally valued together, from 1*s*. 2*d*. per foot to	2	0
For sash-frames with oak-soils, pulley-pieces and outside linings of ditto, inside ditto of deal, the masters charge, with astragal sashes of good Norway oak, from 1*s*. 6*d*. to	2	0
Surveyors allow from 1*s*. 4*d*. to	2	0
The materials of sash and frames together, to the above particular, are worth per foot —	0	7
The nett labour to ditto, sash hung double is about —	0	6
The real or universal price therefore per foot together should be	1	4
Astragal sashes alone are worth per foot, with materials, and well made	0	9
Ditto, stuck with an ovlo —	0	7
The masters charge for the former	1	0
For the latter from 10*d*. to 11*d*.	0	11
For sash-frames, with oak pulley-pieces and soils, the out and inside linings deal, the head fineered, and oak sashes, struck with an ovlo, the masters charge —	1	9
Surveyors allow from 1*s*. 3*d*. to	1	8
The materials are worth per foot	0	6
Labour — —	0	5
The price therefore should be	1	3
For deal sash-frames and sashes the masters charge per foot —	1	0
Surveyors allow from 7*d*. to	1	0

	S.	d.
The materials are worth per foot	0	4
The nett labour $3\frac{1}{2}d.$ the genuine price therefore per foot ſhould be —	0	10
Deal ſaſhes alone are worth per foot to a maſter — —	0	5
Saſhes to fronts of ſhops, of mahogany, ſtuck with an aſtragal and hollow, to a maſter are worth per foot ſuperficial — —	1	0
Maſters charge from 1*s.* to	1	3
Surveyors allow from 10*d.* to	1	0
The materials to mahogany ſaſhes are worth per foot —	0	6
Ditto, all ſhop-fronts that are made out of the common method, ſuch as octagon, figures, &c. are worth per foot — —	1	8
The nett labour to ditto —	0	11

Circular figures double meaſure.

Ditto, of wainſcot or deal, the ſame as common ſaſhes, to a double price.

LECTURE XXX.

OF DOMICAL SKY-LIGHTS.

A Domical ſky-light is a part of the branch which requires a great deal of practice, or at leaſt if it be put into the hands of a perſon unacquainted with its principles, he ſhould be a tolerable adept in other particulars of practice, as well as have a profound knowledge of lines; not that there is any thing

thing very extraordinary belonging to it, more than other circular work, after the consequence of the weather is guarded against, which must be maturely considered before he cuts one piece of stuff.

The best method of doing this sort of work, in my opinion, is to make stiles of the upright ribs (though it be not the common rule) as having by this a better opportunity of rabbiting the rails, which must be done for the upper end of every pane of glass, so that the pane above shall reach over $\frac{1}{4}$ of an inch, for the clearer effect of discharging the water. The mode of making a sky-light, in point of workmanship, is to make them exactly domical within, and stick them as another sash, making the sash no thicker at the bottom than the top; the outside (for my own part) I would always make straight with the glass both ways, and cut the stiles out in notches, which will appear like stripes one above another, as the dome naturally rises; if the plan be an exact circle, and have a concentrick crown, one templet will do for all the stiles.

The way to get the size of all the rails, to every different sweep, as the dome diminishes to the crown, is, first, draw the size of two ribs, with the outside marked to the glass; and on those ribs set out the section of all the rails; from which draw perpendiculars into the ground-plan, which will give you the exact size of every circle to the crown; to every one

one of thoſe it may not be amiſs to make moulds, which will more pertinently point to the learner the length of the rails, becauſe upon each mould, and at every ſtile he can ſet out the exact ſize of the ſtuff, and thereby be ſurer of his lengths; when theſe things are once got, he may proceed with the ſame accuracy as in other circular works.

	S.	*d.*
The value of a domical ſky-light, if meaſured ſingle, is worth to a maſter per foot —	5	6
Materials to ditto, of wainſcot, per foot — —	2	0
Of deal — —	1	8

Saſh-makers can afford them conſiderably cheaper.

LECTURE XXXI.

OF STAIR-CASING.

OF all things to be conſidered in a building, there is nothing ſo material as ſtairs, nor any thing that requires half the abilities, either to plan or execute. Theſe may therefore juſtly be called the maſter-piece of accommodation in every edifice; for, on a proper diſpoſition, or diſpoſal of ſtairs, depends (in a great meaſure) not only the ſtrength and beauty, but the chief eaſe and deportment of the whole ſtructure.

A whole

A whole volume might be written upon this ſubject, and when done, ſo various and extenſive is the manner, as well as mode of execution, that this very eſſential point muſt at laſt be unavoidably left to the builder's judgment, without it were poſſible to define every plan and ſituation that could in any wiſe happen; a thing totally beyond the power of art. However, it will not depreciate the judgement of any architect, to give this point a particular conſideration, before one ſtone or brick be laid; and not (as many do) leave an article ſo material to the whole, to be jumbled up without either grace or freedom.

Many people are of opinion, that there is no difficulty in ſtairs, provided there be room enough. I muſt allow, that to the workman it is much eaſier, when the place aſſigned is ſpacious, the ſtories high, and entirely void of impediment; but, at the ſame time, it is alſo to be obſerved, that it will require a maſterly thought in the architect, to allow ſuch a vacuum or opening, without endangering the ſtrength of the ſtructure; this particular is to be maturely conſidered, and not for the ſake of ſo neceſſary a part ſacrifice the conſequence of the whole building: though (on the other hand) it would be the height of imprudence, to conſtruct, or deſign one inelegant or inſufficient to the purpoſe; and by endeavouring to avoid one error, plunge into ſimilar abſurdities; it is upon theſe principles therefore that our judgement ſhould operate;

ſtudying

ſtudying firſt their intent, properties, and convenience; the nature of the building will pertinently point out the mode of execution, and what will be adequate to the reſt of the works propoſed; the whole of which, more than the executive part, muſt depend, and that ſolely, upon the builder, or ſurveyor's judgement.

Several rules and precepts might be laid down, concerning the form, as well as management of ſtairs; ſuch as to have a liberal light againſt all caſualties of ſlips and falls; that the headway, or ſpace above, be in every reſpect free and lofty; that half paces be judiciouſly diſtributed, and at competent diſtances; that the breadth of ſteps be never more than ſeventeen inches, or leſs than eleven; and, that they exceed not by any means ſeven inches in height, in order to prevent our legs from labouring more in elevation than diſtenſion; that to prevent encounters by the way of paſſing, ſtairs ſhould never be leſs in latitude than four feet ſix inches; and many more of the like obſervations might be made, though they cannot be ſtrictly adhered to, for this ſpecial reaſon, that every ſituation of ſtairs is tied down to the rules of diſcretion, and under the neceſſity of providing againſt its own inconveniences.

Now though it may not be amiſs, for every ſurveyor or builder, in the firſt deſigning of a houſe, to conſider the nature of the work itſelf; what ſort of ſtairs have the beſt effect,

both in form, and when executed; he perhaps might avoid, in some measure, those technical contracted plans, which are treble the expence of elegant stairs, and which often destroy that gracefulness which should consist in an analogy, or correspondence, with the beauty of the whole building.

It is from the forementioned observations, that the principles of stairs will ever be a matter of the first consequence in every age and to every student; for unless it were possible to communicate wisdom, some people would not be benefited by a volume written upon the subject of planning stairs.

There are many more observations, touching the practice of stairs, which I shall treat of as they may occur to my memory; omitting nothing that may conduce to the benefit of mankind, to whom I humbly dedicate my endeavours.

Though there be as great a variety of forms of stairs, as there are situations; yet their principles of practice are generally reduced to three, viz. geometry, bracket ditto, and those called dog-legged stairs.

Geometry stairs are of that construction which seems, to the illiberal and vulgar, to have no support for the steps, having neither carriages, nor leading-pieces to bear them; the properties of which I shall hereafter define.

Bracket ditto, are such as have strings and newels, and are supported by carriages and

leading-pieces of timber; the bracket of which is mitred to the end of the riser of the step, and finishes upon the string-board, which is moulded like an architrave, &c.

What are called dog-legged stairs, are such as have no vacuum or space between the leading or returning flight, but wind round one newel to the top; these, if there be room, have also leading-pieces for their support; if not, they are sometimes fixed into strings on both sides, and put to the bearers for the winders.

LECTURE XXXII.

OF THE PRACTICE OF STAIRS.

BEFORE I begin to define the practice of stairs, I beg the reader to divest himself of all superfluous notions, such as the unconnected lines laid down by many architects, as well as the studied maxims practised by numbers, and follow the sense of his own reason, close with the instructions I shall point out, and I make not the least doubt, but he will (after he has maturely weighed the practical methods I shall here give) be capable of executing any thing that may occur in the course of the whole.

If he be totally unacquainted with this matter, I must entreat of him (if it may not be convenient to take my instructions to his bench) to study them till he know them by heart;

heart; by ſo doing, he will have the advantage of purſuing his work without let or moleſtation.

LECTURE XXXIII.

OF THE PRACTICE OF DOG-LEGGED STAIRS.

THE elevation of dog-legged ſtairs depends ſolely upon the nature and the ſize of the place they are to be fixed in, ſuch as the length and width of the plan, as well as the heights of the different ſtories; but the chief article to be conſidered is the height; for let the plan as to length be ever ſo ſhort, you muſt have a ſufficient tread for the ſteps; the advantage therefore for getting up muſt be taken in the half-ſpace, which may be divided into any number of winders required; for the better underſtanding of which, mark the following examples.

Firſt, Upon a board make a ſcale the ſize of the ground plan, viz. the length and width; in the middle of the width ſet out the newels; and this done, you will have the length of the ſteps.

2dly, Divide your length to the half-ſpace for the number of ſtraight fliers, both going to the half-pace, and returning from it, to the firſt ſtory; then leave the half-pace till you have divided your height.

3dly, By the ſide of the ground-plan continue up your newels; and, having divided

the height into the nearest number of steps you can have, count the number of straight fliers, both going and returning; the remains, to make up the height of the story, must be had in the half-pace, equally divided.

4thly, Continue the lines of the width of the steps upon the plan of the first straight flight, and likewise meet them from the different heights marked upon the newel, which will form the section of the ends of the steps; afterwards, to the treads, set on the projection of the nosings, and with a straight edge, draw a line close to them, which will be the upper edge of the string; next set out the width of the string, allowing for the thickness of leading-pieces, laths, and plaster, &c. Then draw the side of the rail parallel to the string, two feet wide upon the square, with knee, &c. if there be one, and this will complete the geometrical section of the first flight.

5thly, Count the number of winders in the half-pace; at the top of which draw a base line, equal to the length of your returning flight; which may, perhaps, consist of one or two less than the first flight, as may be convenient for the advantage of the landing; proceed then with drawing the section in every respect as before.

The use of drawing the section of stairs is only to give the learner a clearer light into the nature of setting out his newels for mortising, which may be done equally as well

by

by ſetting out the height and width upon a rod: but this is only to be done by people who have had ſome practice, or at leaſt are in poſſeſſion of fertile ideas.

When you uſe only a rod without drawing the ſection, as before obſerved, count the height of the ſteps in the firſt ſtraight flight; from which ſet out the width of the mortiſe downwards; next ſet out the height of the winders, and the firſt ſtep of the returning flight, with the rake of the noſings, which will give you the top of the mortiſe for the returning flight; and proceed with the reſt as before.

The learner is to obſerve, with regard to fixing his middle newel, that the noſing of the firſt winder be exactly fluſh with the inſide newel, that the whole thickneſs may be put into the half-pace; alſo on the returning flight, that the noſing of the firſt ſtraight flier be fluſh with the outſide of ditto into the half-pace: and this order muſt be followed with reſpect to newels in all ſtairs whatſoever.

LECTURE XXXIV.

OF SETTING OUT A NEWEL FOR TURNING.

THE way to make a proper limit for the bottom of the turning, is to take the rake of the ſteps noſings, allowing thickneſs of the capping; and where that falls upon the inſide of the newel, is the mark for turning: the

the newel of the returning flight must have the addition of one step in height, and then the rake of the pitch-board, or nosings, as before observed.

LECTURE XXXV.

OF SETTING OUT A CAP, AND MITRING DITTO SQUARE, BEFORE IT BE SENT TO THE TURNER'S.

FIRST, draw the width of the hand-rail, and add to this the projection of the mouldings on both sides, for the outward diameter of the cap; to which draw a circle; then set within this circle the projection of the mouldings transferred from the straight rail, and draw inner circles to the different members; and also from the straight rail draw the same lines of projection into those circles; and where they intersect, will be the points for mitring the cap, drawn by a straight edge to the point, through different intersections; then cut out the piece neatly, stick it in again with glue, and send it to the turner's.

LECTURE XXXVI.

OF BRACKET-STAIRS.

BRACKET-Stairs differ nothing from what has been already defined of dog-legged ditto, with regard to newels and strings; only those have a well-hole between the leading and returning flight; some square, others crcular

circular or oval; and, inſtead of the ends of the ſteps fitting to the ſtring-board (as before obſerved) the ſtrings are cut for the reception of the ſteps; not through any motive of ſtrength and bearing, but for ornament, that the bracket may be fixed, and mitred to the end of each riſer, againſt the ſtring, with the noſings of the ſteps continued round, which covers the joint of the bracket to the end of the ſtep, and hath a beautiful effect when well executed.

The ſame method, with regard to drawing the ſection of ſtairs, as before obſerved, I would ſtill propoſe to learners in every reſpect, both for ſtrings and rails, as well as ramps and ſcrolls, which will anſwer every point, both with reſpect to knees, balluſters, &c.

There is no difficulty in theſe ſtairs more than the clean execution; balluſters exactly dove-tailed into the ends of the ſteps, within the noſings properly divided; the riſers all glued to the covers, with backing-pieces glued on the inſide of the ſtep; and, when put up, the under ſide of the ſtep nailed or ſcrewed into the under edge of the riſer; and, when finiſhed, put on the brackets of ſtrength under the ſteps, well nailed to each leading-piece.

I muſt inform thoſe who are unacquainted with the method of gluing riſers to ſteps, that the beſt method is to make a frame, or templet, to fix them in, with a place cut out for the projection of the noſing; afterwards glue

on the hollow under the nofing, and work them when together.

I hope the reader will underftand what I mean by a templet; it is only fixing two upright pieces in any thing, with notches cut out of each, the exact projection of the nofings, to which put the front edge of the ftep, and then glue the rifer to the cover clofe to the above pieces, &c.

LECTURE XXXVII.

OF GEOMETRY STAIRS.

THE practice of geometry ftairs, which hath ever been confidered as a mafterpiece of art, is founded upon as great a principle of ftrength, as is requifite for the confequence of the invention; which is only to carry a certain weight, or vibrating ponderofity, in any cafe inferior to the power that fuftains it.

In order to prove this, we have only to meafure the length of the ftep, and weight of ditto and rifer, added to what we propofe to go into the wall; then meafure in the nature of continued quantity, as I have already defined in the lecture of the lever, fimilar to the following example.

The power that equi-ponderates with any weight, muft have the fame proportion unto it, as there is between their feveral diftances: if a ftep therefore be four feet clear, and fix inches

inches into the wall, the weight upon the end in the wall muſt be as eight to one.

Suppoſe we ſay the weight of the ſtep and riſer, with the weight of a man, which we will call 20 ſtone; that multiplied by 8 gives 20 hundred, for the power to ſuſtain a man upon the end of one ſtep naked in the wall; but we muſt conſider that three fourths of this weight will be taken off by the ſupport of the under ſtep: if we divide 20 therefore by 4, we ſhall find that 5 *cwt.* or 70*lb.* placed upon the end of every ſtep, looſe in the wall, will be ſufficient to carry the weight of any man, without either wedge or nail; provided any thing be placed to keep the ſteps in their proper poſition; but what is this trifle in compariſon to the preſſure of a wedge, and the weight of a wall, or truſſing of a partition! which, with interſtices properly framed, will be adequate to the conſequence of any ſtairs thus conſtructed.

The reader is to obſerve with regard to ſteps of longer bearings than 4 feet, that it will be neceſſary to augment the thickneſs of the covers, according to the following proportion.

All ſteps of four feet clear ſhould not be thinner than $1\frac{1}{8}$ inch ſtuff; and for every ſix inches more of length, one eighth more ſhould be added to the thickneſs; alſo that geometry ſteps go into the wall one tenth part of their length.

There

There are a kind of geometry ſtairs which wind round a column or pillar, whoſe bearing or certain gravity tends to one centre; theſe muſt be a little mortiſed into the pillar, the riſer about an inch, and the tread as much as the ſquare of the end of the cover will require, to be juſt clear at the points.

Theſe ſorts of ſtairs are moſt frequently uſed for pulpits, &c. and would almoſt hang with the common ſupport at the top and bottom; however, the additional bearings into the pillar are of great ſervice.

The method of putting theſe ſteps together, if they be clean worked on the under ſide, is to dovetail the riſers into the cover: and when put up, ſcrew the ſtep to the under edges of the riſers all the way up; afterwards fit in pieces of wood, neatly matched, in the holes made by the ſcrews; the brackets are mitred to the riſer, and the noſing of the ſtep continued round. This is much the cheapeſt way of doing geometry ſtairs; but there is a great defect of weakneſs in the brackets hanging in the above manner, looſe as it were, and having nothing to ſupport them from every caſualty; yet to me the ancient method of moulding the ſteps underneath, in the form of the bracket, is heavy, unnatural, and very expenſive, eſpecially to winders.

There is another method made uſe of by ſome, which is the putting up blocks, and ſcrewing them well together; and after covering them with riſer and tread, inſtead of

 brackets,

brackets, framing the under side of them, so that each step appear as solid: these sort have not a bad effect, were it not that the expence is so very extravagant.

The best and simplest method of making geometry stairs, is, to put up a string as in others; mitre the bracket to the riser, and finish to the string; then lath and plaster underneath, and finish with light belexion mouldings of plaster; also if the building be elegantly finished, it may not be amiss to introduce a light ornament in basso relievo.

It is necessary here to observe, that the risers of 2 inch stuff, to geometry stairs of this sort, would greatly add to their solidity.

I think it needless to say any thing more relative to the properties or practice of stairs, seeing the forementioned hints, with a little experience, must be sufficient to a very ordinary capacity; I shall instantly proceed therefore with my remarks on the nature of hand-rails, &c.

LECTURE XXXVIII.

OF HAND-RAILS TO STAIRS.

THE manner of gluing up a twist to the scroll of a hand-rail, hath ever been (by workmen) esteemed a master-piece of the branch, and is considered by numbers as an incomparable stroke of art; in order therefore to render this part of practice as clear as possible to the different capacities of workmen in general, I shall be as circumspect as the subject

ject will allow, through an earneſt deſire that no man may lack any thing in my power to communicate.

The firſt thing the learner ſhould conſider, is the nature of a ſcroll; its extent, and the cauſe of the twiſt. Theſe things once underſtood, the practice of it will be obvious, and rendered very familiar. Whoever was the firſt inventer of a ſcroll to a hand-rail, I will affirm, that he was a man of enlarged ideas; and, though the invention be rather inadequate to an elegant ſtructure, and inferior to ſomething which might be propoſed for the purpoſe, it is, notwithſtanding, judiciouſly contrived, and hath an eaſe in its mode of finiſhing, which will ever render it an object of notice in every age.

A ſcroll is the periphery or circumference of a number of circles in a declining ſtate, each leſs than another; to draw this therefore it requires nothing more than to find out the centres, from whence lines laid down to various points, ſhall have given differences; which, when once found, will always be the centers required to form the volute; and may be either extended or contracted in number at the diſcretion or the workman, or as the ſize of the plan may require.

The cauſe of the twiſt is the geometrical elevation of the hypothenuſe of a right-angled triangle, which muſt of courſe turn up when moved from its direct line of elevation; and will be more or leſs according to the height

height or raking-line of the pitch-board, the pitch-board being the right angled triangle before mentioned, which is made from the height and width of the ſtep; and being cut diagonally, gives the hypothenuſe, or rake of the rail.

The intent and nature of a ſcroll, is to finiſh upon a level the raking of the rail; which, if not brought to this concluſion, muſt either be ended in a newel, or would finiſh on the ground; becauſe every raking-line hath an intent or tendency to a point of reſt; therefore, in this caſe of a hand-rail, it is wittingly ſtopped in its courſe, and brought to the above judicious concluſion: ſo that in the ſimple practice of this, the learner has nothing to conſider but the height he hath to riſe, which is one ſtep, from the level part of the eye to the height of the pitch-board, which will directly meet the raking of the ſtraight rail, and muſt be effected with an eaſy decline, in the natural winding ſtate, to the very edge of the ſcroll.

To the gluing up this there are three principal things to be conſidered:

The firſt is the matching or appropriating the ſtuff, ſo as that the ſtraight rail and grain of the twiſt ſhall unite, and appear as if cut out of one entire piece of timber.

The ſecond point to be conſidered, is the ſituation of the raking part, and how much is added to it by the elevation, which bears the

ſame

ſame proportion as a raking moulding to a level one.

The third and laſt conſideration is the falling of the twiſt from the ſtraight rail to the eye of the ſcroll, which muſt be done in ſuch a manner that it ſhall appear with eaſe and beauty.

People who have had practice in gluing up hand-rails, muſt have acquired every tenet relative to it, and have no occaſion to gather the leaſt inſtructions that may or can be propoſed by any author. To ſolve this particular for practice, to thoſe who have not, is the great ſource of this article; I will propoſe therefore the ſimpleſt method in art and nature, in order to form a proper conception adapted to the weakeſt capacity.

LECTURE XXXIX.

A DEFINITION OF GLUING UP HAND-RAILS WITHOUT LINES.

SUPPOSING a man have a thing of this ſort to do in a remote part of the kingdom, where there is not an architect-book in poſſeſſion either of the maſter or himſelf, and the whole idea they can form of the matter, is, that upon the firſt ſtep the hand-rail turns round to an eye or cap of a newel, and forms a ſcroll, to ſuch a perſon I propoſe the following method:

After he has put up the ſteps, and cut out the firſt by his eye to the beſt appearance he can

can, let him plane up the ſtraight part of the hand-rail, and lay it down upon the noſings of the ſteps: ſecondly, let him alſo cut by his eye a mould to the ſize he propoſes his hand-rail, obſerving to give the eaſieſt turn to the rail he can; not abridging the ſweeps, but bringing them down within two inches of the front of the ſtep, then turn them round to the eye, after the beſt manner he is able: thirdly, let him cut by this mould a piece or block for the eye thicker than the depth of the ſide of the rail, by ſo much as the thickneſs of the pitch-board is, from the baſe line to the rake, two inches from the firſt point; which will be as much as the rail hath to fall, from the ſquare of the twiſt to the eye: fourthly, let him get out one or two pieces to make out the width of the twiſt, and glue them againſt the ſide of the ſtraight rail, and to this block, which will make the whole; obſerving that theſe pieces, which make the twiſt, are to be cut with the pitch-boards raking line; which, when glued, or proffered to, will be anſwerable to the block and ſtraight rail, and alſo give the riſe of the twiſt.

When theſe pieces are held againſt the rail, the learner will find, that he will want wood upon the top-ſide of the ſtraight rail, and the under-ſide likewiſe; theſe muſt be glued on, or left upon the ſtraight rail ſolid before it be planed up; I ſay, if he glue the pieces on, and cut the outſide of the rail by his eye, as near as he can, ſquare from the ground-plan,

and

and from the outside square the top of the rail, and gauge the width and thickness, from these two sides, neatly cut by his eye, I do aver this method will do; and, if he hath a good eye, will have a pretty effect without ever a line.

Though some adepts in the practice of hand-rails would laugh at such a method, I beg leave to tell them, that I have laid down the lines to several people, and shewed them their properties, yet have not been able to make them understand, without having recourse to some similar practices of this kind; not that I propose this scheme to men who have either seen, or have the least conception of stairs, or hand-rails; but to learners who have had no practice, and who may not have the least idea of it.

To people who have a knowledge of business, there are other considerations: First, the raking-mould, which must be made adequate to the length and width of the twisted part when held upon the rake, and perpendicular to the ground-plan; likewise the mould for the back or fall of the twist, from the straight part to the level part of the eye, both outside and inside.

Many people use no mould for the inside of the rail, but make the top or back of the rail square from the outside. But this method is not so good; for if it be done in that manner, when you mould the rail, the fall from the straight

ſtraight part will be too rapid, and cauſe a ſort of lameneſs.

The next method, or matter to be thought of, is the ſquaring of the pieces before they are glued on, which may be eaſily done, and is a common practice; and when they are glued on, to be finiſhed and moulded, one joint is left open to be broke, for the better convenience of working the ſcroll.

The way to find the raking-mould for the curve or turn of the twiſted part of the hand-rail, is, firſt to draw the ground-plan of the rail, and thereon repreſent the pieces which are to make the ſcroll, or twiſted part of the rail; upon the ground draw the width of the firſt ſtep; then laying the pitch-board down flat upon the plan of the firſt ſtep, the baſe of the pitch-board againſt the rail, draw the width of the rail into the raking part of the pitch-board, which will give the width of the end; likewiſe draw the height of the turn of the twiſt through the pitch-board, and ſquare from the raking-line; and draw different lines from the plan drawn through the raking part, and take off the ſeveral diſtances with your dividers, from the baſe of the pitch-board to the plan, and transfer them from thence to the raking part, in the manner of an angle-bracket; and you will have the raking mould required.

But things of this ſort are much better underſtood by lines, or inſpection, than deſcription; in caſes therefore of this ſort, as well as

for the method of drawing a ſcroll, I refer my reader to thoſe drawn, with their manner of performance, as ſhewn by architects.

Obſerve, that if you make uſe of a raking-mould (though many do without) you muſt make it of paſte-board, in order that it may bend to the declivity of the rail; otherwiſe you cannot ſo well mark the top of the rail by it. By the raking-mould your pieces are to be cut for the turn and width of the rail; the mould for the fall of the twiſt, and regular curve for the top of the rail, are done in the following manner.

Upon the ground-plan, where your twiſt begins upon the ſtraight rail, divide the outward curve-line into any number of parts, and transfer them upon a ſtraight line; at the end of theſe place the pitch-board, which you will underſtand is the height you have to riſe; then divide the raking-line of the pitch-board into any number of parts, and likewiſe the remainder of the ſtraight line, from whence you began the firſt part you transferred from the plan; afterwards draw interſections of ſtraight lines, which will exactly give the curve of the under ſide of the rail; and ſet up the depth of the ſide of the rail parallel to this, and you will have the curve of the whole twiſt ſtretched out; with this mould you are to cut your pieces both at the top and bottom; alſo the ſtraight part of the rail that begins to turn up, right away to the level of the eye, and your work will be properly

ſquared

ſquared before it is put together; obſerve that in the gluing of them, you do not ſet them twiſting one to another, and likewiſe perpendicular to the plan.

LECTURE XL.

THE METHOD OF DRAWING A SCROLL.

THE method of drawing a ſcroll is to form a circle equal to the width of two ſteps, divided into eight parts: from the centre draw a leſſer circle, for the ſize of the eye, larger than the width of the rail by the addition of the mouldings, as a cap to a newel; from the firſt draw a tranſverſe diameter, and through the centre again draw a conjugate one; then from the outſide of the inner circle, to the large one of two ſteps, divide the upper part of the conjugal diameter into eight parts, for the diminiſhing ſcale; from the outward circle, upon the laſt mentioned diameter, draw a line to the outſide of the ſtraight rail to the point of the tranſverſe diameter, ſet the other point of your dividers, and deſcribe a ſweep to the diagonal line, which will be the width of the ſcale; the eight parts drawn through this, to the point of the diameter at the outſide of the rail, will give the different parts; all to be ſet upon the diameters, or eight parts, as they follow of courſe; when ſo much is done ſet your divider from the centre of the eye, to the outward part of the circle, and move it to the firſt eighth part, next the

ſtraight rail, making a mark in the eye; and likewiſe from the diameter, or a little above upon the ſtraight rail, ſet your point, and find the mark in the laſt made, which will be the centre for the firſt eighth part; then proceed with the ſecond; and ſo on to the eye. If this be not plain enough, I muſt refer the reader to the drawing of a ſcroll.

Obſerve, that there is no neceſſity to make a ſcroll equal to two ſteps, nor to follow the manner I have ſaid of the ſize of the eye; either of which may be made larger or leſs, as fancy inclines the artiſt; only conſider the ſize you make the outward circle, and from that to the inner one, divide the ſcale into any number of parts you chooſe to diminiſh by, and draw, or divide the greater circle into the like; proceed then as before; ſometimes a ſcroll is made equal to a ſtep and a half; ſometimes but one ſtep; and ſometimes but a quarter of a revolution; according to the taſte of the ſurveyor or builder.

LECTURE XLI.

OF RAMPS.

A Ramp is a portion of a circle; the centre of which being formed by a ſquare line drawn from the rake of the rail, and the level of the knee at the top of the half pace continued to this line, gives the centre for drawing the curve of the ramp, which is in height the riſe of two ſteps; ſometimes in parti-

particular cases, such as where there are winders, ramps rise three or four steps; but these have a bad effect, owing to the upper part of the ramp having almost no curve.

Ramps, if possible, should be cut out of the same plank with the straight rail; in the last mentioned case, the ramp must be glued on to the straight rail.

LECTURE XLII.

OF GLUING UP HAND-RAILS TO CIRCULAR PLANS.

THE many various forms and modes of disposing, to the best advantage, a decrepit or bad concerted plan for stairs, often draws a fertile genius to wrestle with inconveniences more destructive to his tranquillity, than matters apparently of much more consequence.

Stair-casing may justly be called an art of peculiar tendency, because the more labour is spent in the execution of its particular parts, the more it is subjected to bad causes and ill effects, from the very motives that should add grace and freedom to the nature of it, which is in the manner of the hand-rail, and can never by any scheme be made pleasing if stretched into any irregular form, as upon plans that consist of a compound or mixture of steps, such as winders and fliers.

Stairs of this sort cannot, by any power in wisdom and nature, be made to have either a

pleasing or a good appearance; yet it will not be possible always to avoid them.

It is greatly to be lamented, that the difficulty required to execute all irregular plans to stairs, should not make surveyors more careful in the disposing of them, seeing they have not one good quality either in circumstance or mode to recommend them; and yet so infatuated are the builders of this age as to things of this sort, that we scarcely see one good building, but it is merely contrived for a pile of these unnatural productions.

However, since these alone are the taste of the times, it is fit we should endeavour to point out the most simple and judicious method for executing their hand-rails.

There are many ways of gluing up a hand-rail to a circular, oval, or elliptical plan; but the best, in my opinion, if we have but little ground or opening, is, to do it in thicknesses after the following manner; first, glue up a cylinder of plank to the size of the well-hole, and having rounded it to fit the plan, draw upon it the section of the ends of the steps.

If it be an entire circular plan, a straight edge will touch all the nosings, and the rail will be in a proper natural rising position; but if we have any straight fliers before the winders, and the same after to finish the story; the rail, instead of retaining its natural figure, will, through its own inconveniences, be transformed to the shape and almost figure of an S; for the learner is to observe in hand-

rails

rails of this ſort, that an additional length is obliged to be given to the baniſters, in the circular part upon the winders, in order to remedy the defect which is cauſed by the ſudden elevation of the ſteps; and which for diſtenſion, or breadth of covers, throws us above our natural poſition both in aſcending and deſcending, and obliges us, for the benefit of having hold of the rail, to have recourſe to the above experiment; for without this, we ſhould be in danger of falling over the rail in the above-mentioned part; that very place therefore, which ſhould in reaſon (to give a pleaſing appearance to the rail) be loweſt, is for the motive above-mentioned unavoidably and indiſpenſably confined to be the higheſt.

There are ſome neceſſary obſervations relative to the practice of theſe rails; the firſt is, the conſideration of the matching of the ſtuff, which is to be contrived and cut out of one entire piece of timber, and the fineers all appropriated to the ſame places they are cut off, in regular ſucceſſion; obſerve alſo, that in the getting this timber cut, you maturely ſtudy the ſize wanted both ways; and remember, that to a rail of two inches and a half, it will require a piece of timber ſix inches wide, to allow for the ſaw-carffs and planing up, eſpecially if the opening doth not exceed two feet.

There is another obſervation, relative to the depth of the ſtuff, for the ſize of the rail,

which requires ſome thought, if the plan conſiſt of winders, and ſtraight fliers to finiſh the ſtory; for the learner is to obſerve, that the turn required to the rail, both to the winders and from them, is ſubjected to a cauſe which he never would think of, till either practice or inſtruction convinced him; therefore that it will be highly requiſite for him to leave an inch more breadth to the fineers, than the depth of the rail; the ground of this maxim is, that no body of fineers applied one upon another in a riſing ſtate, if they be turned from their natural courſe, either up or down, but will vary in the laying, as much as the difference of the two twiſts, between the firſt mentioned ſtate of riſing, and that which the rail is turned to when continued to the fliers; and perhaps, according to the ground of the opening, one thirty-ſecond part of an inch; if your rail, therefore, require to be glued in twenty-four or more inches thickneſs, you will be ſo many half-ſixteenths of an inch out of ſquare in the turning part (more or leſs, according to the plan, and number of fineers required;) this width then muſt be given to the fineers before they are laid, to be ſquared off afterwards.

In order to lay fineers upon a cylinder, obſerve the following example: If you have no convenience for doing this, and are obliged to make uſe of bed-ſcrews or wedges, lay all your fineers together upon the cylinder, and ſcrew them down all the way dry, and having

ing prepared pieces of wood to lie acroſs the rails at 9, 10, or 12 inches apart, with holes bored through them ſo as to anſwer to be cloſe to the rail; oppoſite to theſe bore holes again in the cylinder, fit to receive them. If the cylinder be of plank ſtuff, this will be ſufficient attraction; but if thinner, I would propoſe the ſetting your cylinder upon ſtools, or legs, for the convenience of getting underneath, and put the ſcrews through the under-ſide, making uſe of the nuts upon the top for confinement; having then looſed one half, take the aſſiſtance of two men, one to hold up all the fineers, the other to lay them down ſucceſſively as you glue them, and afterwards all hands to be fixing the ſcrews; this, if well done, will be the moſt judicious method of making any rail of this conſtruction; and having ſo done, proceed as above, to the other half.

The reader is to obſerve, that if the rail be for a regular plan, either circular or oval, he will have no occaſion to augment the width of his fineers more than is juſt neceſſary for clearing off, becauſe the rail will come off the cylinder ready ſquared. With regard to the number of fineers to form the adequate thickneſs, you muſt be ſomewhat particular, in order to have a few ſhavings to plane off the outſide; becauſe where the ſcrews are applied, the fineers will naturally be cloſeſt, and conſequently leave hills between, which will want planing off when ſtruck.

The

The learner is to take notice, that if he hath not leiſure to wait till the rail be dry (which, in the beſt weather, will require three weeks) he may proceed as before, and glue down another by the ſide of it.

Many of the profeſſion argue againſt rails of this ſort, and give a preference to gluing them up ſolid; but I cannot ſide with them in opinion.

To an opening of three feet and a half, or four feet, where the rail may be cut out of one entire plank, that may be a feaſible method. The great point of matching the ſtuff to ſmall-grounded plans (glued up ſolid) will ever raiſe objections to the rectitude of this mode of appropriation, beſides the danger of ſo many joints, and all glued acroſs the grain, which creates a fault in the ſtrength, and is in no wiſe equal to the purpoſe. However, if the learner be infatuated to this method, the beſt way that I can propoſe for the execution of it, is, ſtill to make uſe of a cylinder, and either cut the top off to the poſition and riſe of the ſteps, and ſquare from the perpendicular of it, which will be adequate to the ground; or elſe cut out the pieces, and fit them ſide-ways to the cylinder, by the noſings of the ſteps, as you would do with the fineers.

This work may be done without the trouble of making a cylinder, by finding or making a mould for the backing of a rail: but there is a great difficulty attends this practice, and it is hardly to be found correct. Every

author who hath attempted the manner of laying this down, is in point of diſgrace; none having arrived at a proficiency, nor is it to be well done without practical alluſions: As I lay down no lines, and a deſcription without them would, in this particular, be no ſervice to the learner, I muſt beg his excuſe, and refer him to the true methods alluded to; which, when once he is in poſſeſſion of, will furniſh him with comprehenſions for any other ſubject of this ſort.

I beg likewiſe to obſerve to the learner, that if the plan conſiſt of fliers and winders, in the meeting or joining of theſe two parts he will be careful to give the rail as eaſy a turn as poſſible, and not directly follow the ſteps; alſo that he leave wood both at the top and bottom ſide of his fineers, at the joining of the twiſt to the ſcroll (if it be a regular circular plan, it will require very little) and with the ſcroll proceed in every reſpect as to a ſtraight rail.

With regard to ſtrings to circular ſtairs, I would not propoſe the gluing them up in fineers, but ſolid; eſpecially, if the plan be only circular at one end; in ſuch a caſe glue them up and down in the manner of the cylinder; and cut to the ſection of the ſteps, at the upper edge; and at the bottom in a regular riſing ſtate, as in the ſtraight part.

Strings to circular ſtairs are worth per foot 4*s*. 6*d*.

LEC-

LECTURE XLIII.

OF THE VALUE OF DOG-LEGGED STAIRS.

	S.	*d.*
FOR common dog-legged ſtairs, with bearers and ſtrings included, the maſters charge from 9*d.* per foot to — —	1	0
Surveyors allow upon an average about $8\frac{1}{2}$*d.* or — —	0	9
The materials to ditto of yellow deal, bearers, ſtrings, nails, &c. upon the neareſt calculation are worth	0	$3\frac{3}{4}$
The nett labour about 2*d.* the univerſal price therefore may be, per foot ſuperficial — —	0	7
Rails and baniſters to ditto, of inch deal, planed ſquare to repreſent iron, are worth per foot, if balluſters be included, newels turned, capped, &c. — —	0	6
The labour to ditto is worth to a maſter — —	1	3
Maſters charge, when valued this way, per foot — —	2	6
Surveyors allow from 1*s.* 6*d.* to	2	3
Some ſurveyors meaſure the rail ſuperficial, including newels, at per foot	1	2
and allow per balluſter, with capping, &c. — —	0	3

Which comes partly to the ſame money.

If

	S.	d.
If the newels be not turned, nor capped, the price is, or ſhould be, per foot — —	1	$9\frac{1}{2}$
Ditto turned ballusters of 2 inch ſtuff, per piece — —	0	7
For bracket-ſtairs of ſtrong ſtuff, per foot, the maſters charge —	1	3
If of ſecond-beſt riſers and covers	1	5
Surveyors allow to ditto, from 1*s.* to	1	4
The materials to ditto are worth, per foot, 5*d.* the nett labour well done, about $4\frac{1}{2}$*d.* the univerſal price therefore ſhould be, per foot, 1*s.* or	1	1
The ſtrings meaſured at the above price; the architrave at 10*d.* per foot ſuperficial.		
The brackets, if plain, per piece	0	9
If carved from 1*s.* 6*d.* to —	2	6
For ditto of clean deal, per foot ſuperficial, the maſters charge, from 1*s.* 6*d.* to — —	2	0
The ſurveyors allow from 1*s.* 3*d.* to	1	8
The materials according to the ground of the tread, if very good, are worth per foot — —	0	8
Labour to ditto about 6*d.* we cannot fix the price therefore at more per foot than — —	1	5
Architraves and brackets as before.		
Geometry-ſtairs, of clean deal, with a ſtring, are worth per foot ſuperficial from 2*s.* 6*d.* to —	3	0

 These

	s.	*d.*
These sorts both the masters and surveyors in common are unacquainted with, it being rare to see one done this way.		
The materials to ditto with rises of 2 inch stuff, good screws, &c. are worth per foot superficial, if they be wedged in a plank in the wall, from 9*d.* to — —	1	0
Labour to ditto is worth to a master	1	10
Geometry-stairs moulded under the steps, according to the bracket, are worth per foot, from 3*s.* to	3	6
The materials to ditto are worth	2	0
Labour to ditto — —	1	0
For mahogany hand-rails, scroll and ramp, the masters charge per foot superficial, from 3*s.* to —— according to the goodness of the stuff.	4	6
The mahogany to ditto is worth per foot, of Jamaica wood, 6½*d.* of rattan, 5*d.* labour to ditto is about 2*s.* per foot; the real price therefore should be per foot ——	3	6
Surveyors allow from 2*s.* 6*d.* to	4	0

For all circular rails double measure, which in some respects is too little, as weith-rails, or so; if the surveyors will not be persuaded out of their humour, and will allow no

	S.	d.
more than double meaſure, the price ſhould be per foot —	7	6
Labour to ditto ſingle meaſure	7	6
Allowing alſo 1*s*. per foot for the cylinder, deal rails, ſcroll and ramp, worth per foot — —	2	0
Maſters charge for ditto —	2	3
Surveyors allow from 1*s*. 6*d*. to	2	0

LECTURE XLIV.

OF FRONTISPIECES.

THE word Frontiſpiece imports the fore-ſide or entrance of a door, uſually made richer and more beautiful than the reſt of the exterior work. There are many different ſorts of theſe; but the moſt elegant are ſuch as are made according to the deſigns of one of the five eſtabliſhed orders, invented and delineated by the ancients. The moſt conſiderable of them for the purpoſe is the Dorick, on account of the large projections of its cornice, which prevents the inclemency of the weather from affecting thoſe who may have occaſion to wait at the doors for admittance; a matter of very great conſequence.

The manner of appropriating the orders to frontiſpieces, is to lay aſide the pedeſtal, with all its appurtenances, and let the baſe of the column finiſh upon the firſt ſtep with a ſub-plinth.

The method of proportioning the Dorick order to frontiſpieces, is to let the whole be guided by the proper ſymmetry of the door, in the following manner: Make the height of the door equal to two diameters; afterwards divide the width of the door into four parts, and one will be the diameter of the column; the height of the column, baſe, and capital will be equal to 8 diameters, the architrave, frieze, and cornice are two diameters high; the pediment is in height two ninths of the width; the Dorick column diminiſhes one ſixth of the diameter at the bottom.

The Tuſcan door may be divided alſo into four parts, one of which is the diameter of the column; the height of the column, with baſe and capital, is equal to 7 diameters, the entablature 2, which make the whole height 9 diameters, the pediment as before.

For the Ionick front, the door's width muſt be divided into 9 parts, two of which are the diameter of the column; the height, with baſe and cap, is 9 diameters, and 2 the height of the entablature, which makes the whole 11 diameters high; the proportion of the pediment the ſame as before.

To proportion a Corinthian frontiſpiece, divide the width of the door into 5 parts, one whereof is the diameter of the column; the height, with baſe and capital, is 10 diameters; the entablature 2; the height of the pediment 2-9ths of the width.

The

The general proportions of the Compoſite order are the ſame as the Corinthian.

The component parts to each front may be had by conſulting the orders, as a deſcription here would not make any addition, or be at all clearer than may be ſeen by inſpection. The practice of frontiſpieces may be reckoned equal to any thing in the buſineſs; it may not be amiſs therefore to point out its properties, and where the difficulties lie, ſo that the learner may proceed with judgement and accuracy.

The deſign being fixed upon, and the ſeveral mouldings laid down at large, with the pitch of the pediment, diameter of the column both at the bottom and top, with the cap and baſe drawn from them, &c. the firſt thing the learner ſhould turn his thoughts upon, is the gluing up the columns, which cannot be trifled with; for theſe being badly executed, will totally eclipſe the beauty of the whole; notwithſtanding, the vaſt maſs of mouldings, and decorations, ſuch as the triglyphs, mutules, frets, caps, baſes, &c. as well as the circular-ſoffite, and jamb-lining, which are all very eſſential points, and muſt be done well in their place, to render it an object worthy the notice of the publick.

And firſt of the columns.

The learner is to obſerve, that the cuſtomary method of gluing up columns, is to divide them at the baſe and cap into eight parts: which when done will ſhew the thickneſs of

the ſtuff required; to find this, draw the lines acroſs through the circumference, and afterward lay down the lines cloſe by the outſide of the circle, both at the top and bottom of the column, which will ſhew it in an octagon ſtate, and point out the width of the ſtaves both at the top and bottom; this width will vary as much as the column diminiſhes on one ſide; when you have got the width of the ſtaves at the top and bottom, you muſt then conſider that the natural intent of all columns is to be repreſented ſwelling (either from the baſe or from one third of the ſhaft: but for fronts of doors I approve of the former method, or at leaſt within one foot of the bottom;) and cannot be got otherwiſe than by diminiſhing the outſide of the ſtaves equal to one ſide of what the column diminiſhes to the top; the firſt thing therefore, after the ſtuff is ſawn out, is to diminiſh the ſtaves by a board cut for the purpoſe intended.

As the diminiſhing a column is a ſecret to ſome, I ſhall endeavour to point out a clearer and more judicious manner than was ever offered to the publick before.

Firſt, draw a circle for the ſize of the column below; and within it another, which will be the ſize of the top; and having drawn a line through the middle, for the diameter upon it, where the inner circle cuts, draw a line ſquare into the outward circle, which gives a portion of what the column diminiſhes; then, having got a board equal to the length

length of the ſhaft, divide it into any number of parts you pleaſe, ſuppoſe eight; next with your compaſſes divide that portion of the outward circle which the ſquare line cuts off) to the diameter into eight parts alſo; and draw lines from each into the ſquare line, all tending to the centre of the circles, which will give the ſcale. Afterwards take off each part, and transfer them into the diminiſhing board, from the ſtraight edge, driving in brads at each point, about which bend a regular thin lath, which will form the diminiſhing-board required.

Obſerve, when you diminiſh ſtuff, if you are pinched for thickneſs, that you need not plane it off at the top end; for it matters not whether it be taken off the top or the bottom, ſo that it do but fit the templet above-mentioned; and be but at each end pricked off and planed to a regular thickneſs, that the pieces of cants, which muſt be glued on the inſide for ſtrength, fit the inſide of the ſtaves. Having gone ſo far, ſet your bevil to the edge, and make a little templet to fit the outſide of two by the drawing when together, in order to try them, when you joint the edges; and glue them at firſt two and two together; then glue them in halves, and afterwards glue the two halves together, which will complete the whole; for a frontiſpiece you may not perhaps want more than 7 ſtaves, in which caſe you are firſt to glue 6 together by two's, afterward one more, or joint them

one against another in ſucceſſion as you do other joints.

The learner is to obſerve, that if the iron of his joining-plane be not particularly ſquare, when he comes to round his columns, his joints will be open, which will have a very diſagreeable appearance, beſides being very defective in point of ſtrength.

The method of rounding a column is, to cut a board circular the ſize of the baſe, and another the ſize of the top, and nail them on to each end, having bored holes to put pins through at each end, hang them in a creel, by the ſide or on the top of the bench, for the advantage of turning them round; plane them to the templets at each end, and by the diminiſhing board for length, and your work is done.

Baſes and caps are ſometimes glued up as columns, and ſometimes got out as ſolid of different thickneſſes; the latter method is much the ſtrongeſt, though attended with more expence; obſerve in this laſt method, that the thickneſs of the ſtuff be always equal to the moulding, and the joints always in quirks and fillets.

Having done the columns, baſes, and caps, the next matter of material conſequence, is, the fronton or pediment, which is ſuperior in ſize to the level work, in proportion to the pitch; the moulding and other decorations therefore will require to be made adequate to the purpoſe.

The

The ſimpleſt way to find the ſize and curve of a raking-moulding, is, firſt, to draw the level one; from which, ſet out the height of the pediment, and draw lines parallel from the level fillets by the raking line, and parallel to each other at the top end; in any part of the raking lines, draw the ſize of the moulding, equal to this width, with the projections of the level moulding; afterwards draw a line through the face of each, the ſame as you would do to draw the curves of an o-gee or ſima recta; and, having divided this face-line into any number of parts, draw them ſquare from this laſt mentioned line into the moulding, and transfer them to the raking part, which will give the points for tracing the curves; this may be done full as well by pricking off the curves in the middle of the level moulding, and transferring them to the raking one; and, after finding a centre that will ſtrike three pricks, will draw the raking curve required.

The way to cut a raking-mould to mitre to the level one is, to make a pitch-board equal to the riſe of the pediment, and putting it into the mitre box, ſet the moulding upon it; then cut it in the ſame manner as another mitre.

The way to mitre a little o-gee round the block, and mutules in a pediment is, to make a ſmall jack for the purpoſe to ſhoot them in, and glue them on before they are put to the planceer; the learner is to obſerve, that there

 muſt

muſt be three ſorts of mouldings to cap a block upon the rake, which bears this analogy; as the level moulding is to the raking one, ſo is the raking ditto to the returning one of the top, and found in the ſame manner as the other; now as the putting together the different works well, can only be acquired by practice, for any further explanation on that head, I muſt refer the reader to it, as it is impoſſible to communicate execution.

Of a circular Soffite to a Frontiſpiece.

The beſt method of gluing up what is called the ſtiles of a ſoffite, is to do them in two widths, and break the joints; if they are to be ſtuck, that is, framed, you muſt be careful to turn the grain with the edge all one way, for the advantage of ſticking the moulding, and to fineer the ſtiles the thickneſs of the ſquare of the plan; the beſt way of confining a fineer upon any concave circular-work ſuch as the above ſtiles, or ſuch as may be wider, is, to plough a couple of ſuch pieces, and having nailed one faſt upon one end firſt, afterwards thruſt the fineer round with the end into this plough-grove, which will give the exact length; then, when you have laid on your glue, thruſt it in as before, and putting on the other piece likewiſe, nail it faſt down upon the other end, and if your fineer be long enough, the glue will all be properly ſqueezed out without any other force.

If

If the ſoffite be plain, I would only make a fineer, and cut out ribs to bend it upon, with rails acroſs equal to the width, then proceed as before obſerved; after the fineer is on and dry, glue backings on the outſide, which is much the readieſt way, and will anſwer the purpoſe well; the jamb-linings are the ſame as to any other framing.

LECTURE XLV.

OF THE VALUE OF FRONTISPIECES.

FRONTISPIECES, if valued properly, ſhould in every reſpect and part have a different price.

	S.	*d.*
Firſt, the jamb-linings, which ſhould be made particularly well, if of flat pannel, are worth per foot to a maſter — —	1	0
Of raiſed ditto — —	1	3
Of bead and fluſh — —	1	0
The materials are worth per foot, whole yellow deal ——	0	5
Surveyors allow, and maſters charge for them when well done, from 10*d.* to — —	1	4
For the ground to a front, the maſters charge, per foot —	0	8
Surveyors allow from 6*d.* to —	0	$7\frac{1}{2}$
The materials are worth $2\frac{3}{4}$*d.* the labour 3*d.* the price therefore may be	0	7

	S.	d.
If the columns, baſe, and cap, be valued together, which is the cuſtom with ſome, the maſters charge per foot from 1*s*. 9*d*. to —	2	6
Surveyors allow the ſame, according as the work is executed; but the moſt general price is —	2	0
The materials, to ditto, are worth per foot ſuperficial, including the core of timber, which ſhould be put through all columns, to take the weight off the baſe and cap	0	9
The nett labour, with expence of turning, per foot —	0	$8\frac{1}{2}$
If fr. baſes, are ſolid, and the labour altogether well done —	0	11
The real price therefore ſhould be per foot ſuperficial — —	1	10
For all level mouldings, the maſters charge — —	1	2
Surveyors allow from 1*s*. to —	1	2
The raking mouldings —	1	3
Mouldings of all frontiſpieces, as they are, or at leaſt ſhould be, all of good yellow deal, are worth per foot — —	1	0
The architrave and cornice, with frieze taken together, is worth per foot with the triglyphs, bells, &c.	2	6
The materials to ditto, are worth per foot — —	0	6

The

	S.	d.
The method of valuing these, is, to value the blocks or mutules at so much per piece, plain blocks from 9*d.* to — —	1	0
Those with bells in them, from 2*s.* to	3	6
The frieze, at per foot, from 1*s.* 6*d.* to — —	2	0
All the mouldings at per foot —	1	3
The bearers and cover-boards at per foot — —	0	6
The shaft of the columns, per foot superficial at — —	1	6
The base and cap, per foot, at	2	6
The sub-plinth, and plinth of the base, together at — —	0	7
Frets under the planceer of the raking part, per foot ——	2	0
Flutings, upon the facio, per foot	0	6

The above prices, which are the medium of many surveyors prices, are near enough, and not extravagant; the quantity of stuff for mouldings hath already been considered, therefore need no further explanation.

Fan-lights to frontispieces are made from 2*s.* per foot to ——	4	6

Sometimes they are paid by the piece, but this is an uncertain way.

LEC-

LECTURE XLVI.

OF FLUTING COLUMNS OR PILASTERS.

THE way to ſet out a column for fluting is, to divide it at its baſe into ninety-ſix parts, giving one to the fillet, and three to the flute, which will juſt make in number twenty-four flutes, and twenty-four fillets.

The way to gauge a column for fluting, is, to fix a parallel piece to the middle of the column, and turning it round to every prick, or part, as you have ſet it out, run the gauge ſtraight along as in other work.

The method of gauging a pilaſter, having divided it into twenty-nine parts, and given one to the fillet, and three to each flute, is, to make a gauge that will run half of them at once, and afterwards turn it to the other ſide for the other half: if the pilaſters diminiſh, you muſt make a gauge with pricks equal to the whole, cut out to fit the width of the pilaſter at the bottom, and, where it begins to diminiſh, turn the gauge a little a-ſkew, and continue ſo to the top, obſerving to keep the points of the notchings of the gauge cloſe to the outſide of the pilaſter on both edges, thus will your flutes be regular, and diminiſh properly. With regard to cabling columns and pilaſters; ſome people have a method of working cables in the ſolid, with a plane made for the

the purpose; but, for my own part, I do not approve of it, because it doth not work clean. Columns fluted and cabled require the addition of nine-pence per foot, or three-pence per foot run, of every flute and cable.

LECTURE XLVII.

OF GLUING UP CORINTHIAN OR IONICK CAPITALS.

THERE is nothing very difficult in this work, except judgement in appropriating the pieces to their proper places, and applying the grain of the wood the same way the staves glued up; the best way to find this, is to draw the size of the capital, with the leaves, abacus, &c. and their proper projections, which will point out the length and thickness of each piece. The same also of the Composite capital, &c.

Of Chimney-pieces.

Chimney-pieces are a great addition to rooms, and require clean execution; the mode of proportion assigned to them, is the dexterous result of fancy, which at present is in high estimation. There are many elegant and judicious designs published, which might serve as a standard for this sort of work; but custom having long ago bid defiance to propriety, and now stalking abroad without let or molestation, what I have before said of mouldings

mouldings ſhould ſerve as a direction for chimney-pieces as well as the reſt of works of this kind.

	S.	*d.*
For chimney-pieces the maſters charge per foot 1*s.* to — —	1	8
Surveyors allow from 9*d.* to —	1	6
All plain chimney-pieces worked by hand are worth per foot —	1	0
Ditto with breaks —	1	3
With dentils — —	1	6
Fret dentils are charged per foot run	0	6
Common fillet dentils per foot run	0	4
Frets to friezes to ditto per foot run	2	0
Fluting in friezes, 6 inches wide, per foot — —	2	6
Fluting upon facios per foot run	0	8
Flutings and beads in friezes are per foot run — —	0	2

As chimney-pieces are a particular work, the above prices are in general ſuch as take the medium, both with reſpect to the maſters charging, and what ſurveyors allow; I ſhall not enquire therefore too ſtrictly into their merits, becauſe they are ſo very tedious, and take much time to execute.

LECTURE XLVIII.

OF A CIRCULAR SPLAYED SOFFITE IN A STRAIGHT WALL.

A Circular ſplayed ſoffite in a ſtraight wall hath no great difficulty, when a proper curve is found for the ſtiles; the following method is without exception.

Firſt, draw the lines by the ſplay of the wall till they meet at a point; afterward transfer the length of theſe lines to another place; and having divided the circle of the arch into equal parts, and transferred them on to a ſweep ſtruck by the above radius, the ſtile is found; when bent round, it will be the exact curb for the outſide of the wall; then ſet off the ſtile, and proceed as in other circular work.

LECTURE XLIX.

A CIRCULAR SPLAYED SOFFITE IN A CIRCULAR WALL.

A Circular ſplayed ſoffite in a circular wall is upon the ſame principle as the above, though it require more judgement in the execution.

EXAMPLE.

Firſt lay down the curve of the wall, with the ſplay of the jambs, and transfer them as before;

before; then divide the circle into any number of equal parts, and transfer them to the curve ſtruck by the centre, from the ſplay of the jambs; afterwards draw the lines all to the centre; then draw a ſquare line cloſe to the front of the outward curve of the wall; and, having drawn the arch a little below the windows opening, continue lines perpendicular from the parts the arch was divided into, to the ſquare-line laid cloſe to the curve of the wall, and the ſweep ſtruck by the centre and ſplay of the jambs, which will give the points for tracing the curve; this when held upon the ſplay, and bent round, will exactly anſwer the purpoſe: the outſide being once got, proceed with the beſt advantage.

Things of this kind very rarely happen; when they do, they ſhould be put into the hands of men of great experience, and ſound judgement. No reaſonable value can be fixed to this work: the method is to meaſure them four times; but this is too little at the common prices. This method will do in point of ſtuff; but if the work be framed, the prices ſhould be per foot 1*s.* and ſubject to the above meaſurement. In jobbs of this kind, the ſurveyors are obliged to learn the quantity of materials and labour of the maſters, and ſettle a price accordingly.

LECTURE L.

OF DRESSERS.

DRESSERS ſhould be always made of white deal very clean: there is nothing required in theſe but their value.

	S.	*d.*
The maſters charge for two inch dreſſers per foot — —	1	2
Surveyors allow from 1*s*. to —	1	2
The materials are worth per foot	0	6
Labour to ditto 4*d*. therefore 1*s*. per foot is very reaſonable —	1	0
Columns to ditto are worth per foot, 3 by 3, per piece —	1	6
Maſters charge for ditto from 1*s*. 6*d*. to —— ——	2	0
Drawers are worth per foot, of deal	0	7
Runners to ditto per foot lineal	0	2½
Shelves to dreſſers are worth per foot, of whole deal — —	1	7
Common horſe-plane cornice to ditto per foot run —— ——	0	3

Of Slit-deal Linings.

All ſlit-deal linings are worth per yard, of white deal, ploughed, tongued, and beaded — —	2	2
Ditto of whole yellow deal 3*s*. 10*d*. or	4	0

Bracketing

	S.	*d.*
Bracketing to plaster cornices per foot run 5*d.* if 6 inches square; if but 4 inches ditto ——	0	4

LECTURE LI.

OF TORUS-SKIRTING.

TORUS-Skirting is worth per foot 7*d.* Ditto to stairs double measure.

As there is a difficulty in putting this up to stairs, I shall give my learner a method, which, if he pursue with accuracy, he will in this point never err.

EXAMPLE.

First make two templets, one with the nosing cut out, so that it may go close to the riser; the other the width of one of the highest steps made parallel; lay the skirting-board close to the nosings of the steps: then with the templet against the riser mark all the lines for the risers, and with the parallel board strike out the lines to fit upon the treads; observe also, if the covers be a little cast, to set your compasses to the part, and from the top-edge of the board prick off the deficiency downwards; and having procured a piece of one of the nosings, mark on the board as is required for every step; these exactly cut will fit at the very first time; if not, it is of little use; because a second scribing either

either up or down alters the nosings and the general tenor of the whole, which cannot be any way so well executed as at the first time.

Of Trunks.

	S.	d.
Trunks of good yellow deal, well pitched, are worth per foot from 10*d.* to — —	1	0
Labour to ditto —	0	$3\frac{1}{2}$

LECTURE LII.

OF CARPENTERS WORK.

THOUGH Carpenters work must be allowed and considered as the principal source of strength in every building, yet the practice of it is less irksome and difficult than many other of the interior parts of a structure, especially in London, where it is a rarity to see what may be called a piece of good carpentry work: not but there are many capital jobbs in this branch, though they seldom occur, except it be in the country, at the mansion-house of some nobleman, or gentleman, whose chief pleasure it is, to erect something noble, to shew their regard for their paternal estates.

There is nothing very material in the practice of carpentry, more than what demonstrates itself by a drawing; I shall not take up my reader's time therefore with what he

may esteem as trivial observations; but only give some few hints of the particular methods and properties, and proceed with the value and consequence of materials.

First of foundations, as it is the carpenters business to settle the particular under-filings, and subtraction, touching the solidity of the ground.

With respect to piles, or planking, I would advise the builder to have a particular care both for the benefit of others, as well as his own work; and weigh well the consequence of the superstructure by the intended size and height, in order, if possible, to prevent premature settlements, as well as the under conducts or conveyances of suillage, cess-pools for the soil, &c. that they likewise be in no-wise detrimental to the natural grounding of the foundation.

When his mind is at rest with respect to the basis of his building, he must then turn his thoughts to the centring for the vaults. These are of various forms; but the strongest, in my opinion, is the circular; for if the bricks or stones to those were cut wedge-wise, and disposed in the form of an arch all from one centre, such bricks and stones could in no wise sink downwards, for want of room to descend perpendicular; because all solid materials must descend directly downwards, gravity having a natural tendency to the centre of the world, and nature performing all her works by the shortest lines; neither can the butments

butments of a ſemicircular arch ſuffer ſo much as one made flatter, becauſe the roundneſs of it will rather incline the weight to reſt upon than ſhove them out.

There is no difficulty either in the making or ſetting of centres, but what every man who hath ſerved a time to the buſineſs muſt naturally know; yet I ſhall not omit to acquaint my reader, that the moſt familiar method of ſetting centres, is, to cut pieces of quarter equal to the length at the top and bottom, and ſet the bearers upon wedges, for the convenience of eaſily ſtriking them; alſo if the vault be groined, to keep them up conſiderably in the middle, to prevent a defect in appearance by the ſetting of the arch; a thing very common in arches or vaults of a great ſpan.

As ſome young men may be unacquainted with the nature of ſtriking out centres, the following is a certain method, for every part or portion of a circle whatſoever.

EXAMPLE.

Firſt draw a baſe line equal to the width of the arch you intend; from the middle raiſe a perpendicular equal to the height, and likewiſe continue it below the baſe line; then from the height to the point of half the width, draw an hypothenuſe, in the middle of which ſet to your ſquare, and draw a line into the perpendicular, which will be the centre required: and ſo of every other circle.

An elliptick may be ſtruck with a trammel for a rough arch; but the moſt exact and beſt method is to divide half the width and the height into any number of equal parts, and draw interſection of lines, which will form the arch deſired.

The centres being done, the next thing that requires the carpenter's thoughts, is, the plates for the floors to reſt upon in the walls, which are of the greateſt ſervice imaginable, both with reſpect to ſtrength, and form in practice; alſo, if the building be of no conſequence, and require binding-joiſts, conſider well the nature of them, both with regard to ſcantling and diſpoſition, and that they by no means exceed 3 feet 6 inches apart, or 4 feet at the fartheſt, to prevent too great a ſcantling for the bridgings.

The practice of this work is familiar; the binding-joiſts are mortiſed into the girder fluſh with the under ſide, and ſo much below the top as will allow the thickneſs of the bridgings to be equal with the top of the girder; the binding-joiſt mortiſed near the under edge, for the cieling-joiſts at one end, and to ſlip into a chaſe-mortiſe at the other.

Partitions come next under our examination, but require no difficulty: the principal thing in partitions lies in properly placing the braces, ſo that they may in ſome meaſure ſerve as a kind of butment or ſtay one to another; where theſe are uſed, they are both of ſtrength in ſupporting the upper floors, beſides which they

they are a tie to the building by the top rail being dove-tailed upon the plates, though this ſhould not be too frequently uſed, as being leſs ſerviceable than partition-walls; having mentioned theſe things, we will not doubt but the ingenious carpenter will, from the hints before given, remember the adjuncts of ſtrength and convenience, ſuch as bond-timbers, lintels, diſcharging-pieces, taſſels, &c. and have them ſet in their proper places, for the advantage of putting up his own work, and therefore turn our thoughts to the great conſideration of every building, which is the roof, and hath a two-fold meaning, both of equal conſequence. The firſt is, the juſt notion of the benefits intended, which is a ſhelter or covering from the inclemency of the weather; the ſecond, the extremity of the properties of this covering, which requires ſome thought, that they may not be inconſiderately applied either as too heavy or too light; both of which I have in my lecture of ſtrength hinted at, the former having the common objection of preſſing too much the underwork; the latter (though of leſs danger) being always ſubject to the power of a ſtorm.

With regard to the height of the pitch of roofs, the natural effect of the climate ſhould be the only guide; for if the ſituation where we build be cold, and ſubject to heavy falls of ſnow, the pitch ſhould be particularly higher, to give a fall to the gathering weight; though, I think, the common pitch, under-

ſtood by every workman, will be high enough for any part of this kingdom; and ſomewhat under it will do for the cities and large towns, eſpecially for pan-tiles.

The principal thing in the practice of roofing, is the ſcarfing, or raiſing of wall-plates, to find the length and backing of the hip-rafter, to contrive the truſſes that they may take part of the weight from the beams of the principals, and alſo be a ſhore to the length of the rafters; alſo, to lay out the different ſkirts of the roof in ledgement, in order to find out the real length of every piece, as well as the quantity of ſtuff required.

LECTURE LIII.

TO FIND THE LENGTH OF A HIP-RAFTER TO ANY ANGLE.

FIRST, upon your drawing, lay down the principal you hip the roof to, and make a line through the middle of the plan, which is the baſe of the ridge; then draw the baſe-line of your hip; from this baſe-line, in the point of the baſe of the ridge, raiſe a perpendicular, and prick off the height of the pitch of the roof, from which prick, to the outward point of the baſe-line at the angle, draw the hypothenuſe, which will be the length of the rafter required; afterward ſet off the thickneſs at the top and bottom, and you have the form of the hip-rafter with the bevils at each end.

LECTURE LIV.

HOW TO BACK A HIP FOR ANY ANGLE.

DRAW a line acroſs the angle of the roof, parallel from each corner, at any diſtance; in the middle of this line (which will be upon the baſe of the hip) ſet the point of your dividers, and extend the other to the neareſt place againſt the inſide of the hip juſt laid down, then turn your dividers to the baſe-line toward the ridge, and make a mark, which being drawn to the outward points of the parallel line, will give the backing of the hip required.

I think it needleſs to ſay any thing concerning the method of mortiſing and tenoning roofs together, or of truſſing of girders, or ſcarfing of plates, ſeeing Langley and others have ſo largely defined theſe things; that an immediate recourſe to them will ſhew how they are done, and, moreover, things of this ſort are always much plainer by inſpection than deſcription.

It may not be amiſs to mention that tie-beams ſhould not be more than ten feet apart, and well pinned down upon the plates; the ſtrength of a dove-tail being inſufficient for the ſtrength required; and that the pieces appropriated to tie the angles, be of ſufficient ſcantling, well pinned down alſo, to keep every part in due form, and adequate to the purpoſe.

LECTURE LV.

OF THE PROPER SCANTLING OF TIMBERS.

Scantling of Girders.

IF the length of a girder of fir be

	Ft.	In.		In.
	12	9½	by	8½
	14	11		9
	16	12		10½
	18	13		12
	20			
	22	14		12½
	24	15		13
	26	16		13½

Of Binding Joists.

If their length be

	Ft.	In.		In.
	8	6	by	5
	10	7		5
	12	8		5

Observe, that no joist should exceed 12 feet in length, and that it be laid 6 inches in the wall.

Of Bridging Joists.

	Ft.	In.		In.
Length	3	3	by	3
	4	4		4

Common

Common Floorings where neither Binding or Bridging Joists are used.

	Ft.		In.		In.
Length	10	Their scantling should be	7	by	3
	11		8		3
	12		9		3

Of Fir Beams.

Length.	Scantling.			But if of oak		
Ft.	In.		In.	In.		In.
30	6	by	7	7	by	8
45	9		8½	10		11½
60	12		11	13		15

Principal Rafters.

	Ft.		In.		In.		In.	In.
If the rafters be of fir	24	Their scantling at the bottom should be	6	by	7	at the top	5	6
	36		8		10		6	8
	46		10		12		8	9½

If of oak at bottom.			If at the top.		
In.		In.	In.		In.
8	by	9	7	by	8
9		10½	8		9
10		12½	9		10

Small

Small Rafters.

Length.	Scantling.		
Ft.	In.		In.
8	$3\frac{1}{2}$	by	$2\frac{1}{2}$
10	$4\frac{1}{2}$		$2\frac{1}{2}$
12	$5\frac{1}{2}$		$2\frac{1}{2}$

Purlines in large buildings (where they are framed into principal rafters) ſhould be 9 inches by 8; in ſmall buildings, when laid into the collar-beams, 4 by $5\frac{1}{2}$; raiſing-plates, and all wall-plates ſhould be 9 by 5; lentils and diſcharging-pices, 9 by 6; bond-timber, 6 by $2\frac{1}{2}$; taſſels ditto.

LECTURE LVI.

OF THE VALUE OF CARPENTERS WORK.

THE moſt judicious method of valuing carpenters work, is to eſtimate it by the cubical foot at the following prices:

	S.	d.
All warehouſes, ſtorehouſes, and other large buildings, that require large ſcantlings of timbers, may be valued per foot cube for the timbers, at	1	6
With a charge for the labour, ſuch as it may properly deſerve.		
For carpenters work done in large buildings of the firſt claſs —	1	7
Ditto per foot cube		

	S.	d.
Ditto of the ſecond and third claſs of buildings — —	1	8
To buildings of the fourth and fifth claſs, the timbers may be at per foot — —	1	9
All bond timbers and lintels, per foot cube at — —	1	9
Labour to all common roofs to a maſter is worth per ſquare —	9	0
Ditto to kingpoſt roofs, with purlines	12	0
Floors with binding and bridging-joiſts are worth per ſquare —	8	6
All common floors at per ſquare	8	0
All partitions at per ſquare —	8	0
All timber framing is worth per foot cube for labour to a maſter, from $4\frac{1}{2}d.$ to — —	0	8
All framings of timber, ſuch as ſtablings, &c. planed, are worth per foot cube, labour only, to a maſter when of fir — —	1	3
Ditto of oak — —	1	6
Extra work of truſſing of girders at per foot run of oak —	0	8
Ditto of fir — —	0	7
New oak framing at per foot cube	3	6

All old oak wherever appropriated is valued at the price of new fir.

The

The following is the Price and Value of Carpenters Work by the Square.

	£.	s.
Framing of floors, with binding-joints, and all materials of oak, from 2*l.* 15*s.* to — —	3	10
when the timber is valued in ſcantlings at 3*s.* per foot.		
Surveyors allow, when girder, binding-poſts, bridgings, and cielings ditto, are, of oak, from 2*l.* 10*s.* to	3	5
Note, the materials to a ſquare of the above floor are worth, when the oak is cut to ſcantling, at 2*s.* 8*d.* per foot — —	2	8
Labour to ditto 10*s.* therefore 3*l.* 5*s.* per ſquare is as little as can be allowed		
As materials of every kind vary in every county, I muſt beg my reader to abide by the labour in this particular for the country, and value his ſtuff at a fair appraiſement.		
For floors of fir, with binding-joiſts, the maſters charge per ſquare from 1*l.* 10*s.* to — —	2	2
Surveyors allow about —	1	16
The materials at 1*s.* 6*d.* per foot in ſcantlings are worth —	1	4
Labour to ditto 8*s.* 6*d.* the price therefore ſhould be about —	1	18

For

	£.	s.
For common naked floors of fir, the masters charge per square, from 1*l.* 8*s.* to — —	1	18
Surveyors allow about the same for these as the bridging floors; because the quantity of materials run near the same; the latter rather more.		
The price of these floors is not extravagant, when of fir, being per square at — —	1	18
The nett labour to them is about 6*s.* the masters charge —	0	9
Surveyors allow 8*s.* 6*d.* which should be the universal price for labour.		
For framed partition scantlings 4 by 3, the masters charge per square, from 1*l.* to — —	1	5
Surveyors allow per ditto —	1	0
The materials are worth, of fir, 12*s.* the labour to a master 8*s.* therefore we will call it —	1	2
Ditto trussed partitions, labour is worth per square — —	0	10
All bond-timbers, lintels, discharging-pieces, &c. are charged at 1*s.* 9*d.* per foot cube.		
For framing of king-post roofs, with purlines, &c. per square of fir, the masters charge — —	3	10
Surveyors allow from 2*l.* 15*s.* to	3	0

The

	£.	s.
The materials per ſquare of this ſort of framing are worth about 2*l*. 3*s*. the nett labour 10*s*. the price therefore ſhould be — —	2	18
The labour only of this work to a maſter is worth per ſquare	0	14
For common roofs with a ridge-tree the maſters charge per ſquare, with all materials, from 1*l*. 15*s*. to	2	0
Surveyors allow according to pitch from 1*l*. 10*s*. to ——	1	16
The materials to a ſquare of this ſort of roofing, with raiſing-plates, tie-beams, ridge, &c. are worth	1	6
Labour to ditto to a maſter is worth 9*s*. the price therefore is low enough at —— ——	1	15

	S.	*d*.
Extra work to truſſing of girders, beams, &c. at per foot run, of oak	0	8
Ditto of fir, per ditto —	0	7
Bridged guttering, of whole deal, is worth per foot ſuperficial	0	$6\frac{1}{2}$
Ditto with oak bearers —	0	$7\frac{1}{2}$
Rafters feet and eaves-boards for ſlate, per foot ſuperficial —	0	$4\frac{1}{2}$
For door caſes, framed of fir, rabbitted and beaded, at per foot cube, maſters charge ——	2	8
Surveyors allow from 2*s*. 6*d*. to	2	8

The

	S.	d.
The labour to one is worth per foot cube 1*s.* and the materials 4 by 4½, to a door of 6 feet 6 inches by 3 feet 3 inches, are worth 1*s.* 8*d.* the price therefore of 2*s.* 8*d.* is little enough; the beſt way of valuing theſe is to meaſure them ſuperficial, at 4*d.* per foot.		
For centring for groins, per ſquare, maſters charge ——	12	0
Surveyors allow from 9*s.* to —	11	0
The materials waſted, &c. may be valued at —— ——	6	0
The labour to making, ſtriking, &c. to a maſter is very well worth 6*s.* therefore the ſtandard is —	12	0
Framed quarter-paces to ſtairs per foot with materials, from 8*d.* to	1	0
Leading pieces of fir, per foot cube	2	0

LECTURE LVII.

OF PLUMBERS WORK.

PLUMBERS work is all valued by the long hundred or 112*lb.* and bears price according as it weighs per foot, from 4*lb.* to 12*lb.* ditto, being of different ſorts, ſuch as ſheet lead, and milled ditto; the former is uſed for gutters, platforms, and the covering of roofs; the latter for the ridges of houſes, hips, tops of cornices, &c.

I think

I think it but of little uſe to enter here into the quality of lead (which is of various ſorts) ſeeing the plumbers have an opportunity of giving you what ſort they pleaſe.

The plumbers method of doing their buſineſs is to value their work at ſo much per hundred; and afterwards charge you the time for laying and finiſhing, which I think is a very weak as well as indolent method, and fit only to encourage their men in idleneſs.

	£.	s.
The price plumbers charge for 7*lb.* to the foot, is, from 1*l.* 2*s.* to	1	3
Surveyors allow ———	1	2

The value of lead, conſidering the waſte in the melting, is worth per hundred about 19*s.* 1*l.* 2*s.* therefore is ſufficient. I think it a folly in ſurveyors to allow more per hundred for lead of 10*lb.* or 11*lb.* per foot, than 7*lb.* which is the general rule, let the plumbers cuſtom be what it will.

The true and genuine method of valuing plumbers work, is, to ſtate the price for ſheet-lead of any weight above 7*lb.* to the foot at 1*l.* 3*s.* per hundred, which will allow 1*s.* per hundred laying, and this is quite ſufficient.

	£.	s.	d.
Milled lead is of a thinner and finer quality, and ſhould be per foot laid and ſoldered at per hundred	1	5	0
The price of caſting and laying lead is from 3*s.* to ——	0	3	6

Caſt-

	£.	s.	d.
Caſting old lead, and the plumbers making up the deficiency	0	4	9
Water-pipes, from 1 inch to 8 inches bore, ſolder and labour included — —	1	7	0
Rain-water pipes, and pumps, per hundred — —	1	8	0
Water-pipes of large bore per yard or hundred weight.			
The cuſtomary allowance by plumbers for old lead is 14*s*.			
Saſh-weights at per hundred	1	1	0
Solder per pound 8½*d*. or	0	0	9
The price of ſoldering water-pipes is 2*s*. 6*d*. per joint to ——	1	2	0
One of ¾ inch bore is —	0	2	6
1 inch ditto —	0	3	0
1½ inch — —	0	3	6
2 inches — —	0	4	0
3 inches —	0	6	6
4 inches —	0	9	0
5 inches —	0	12	0
6 inches —	0	15	0
7 inches —	1	0	0
7½ inches —	1	1	0
All dimenſions between theſe bear an exact proportion.			
The price of ſtop-cocks are per *lb*.	0	1	3
Ditto, ſetting on ſolder and labour at per cock, of an inch and half diameter —	0	8	0
Ditto, ½ inch, per cock	0	3	0

		£.	s.	d.
One inch ditto	—	0	5	0
Braſs cocks, of an inch and half diameter, with boſſes, ſolder, and ſetting on, per cock		0	7	0
Ditto, of inch, per cock	—	0	4	0
Ditto, ½ inch, per cock	—	0	3	0

LECTURE LVIII.

OF MASONS WORK.

HAVING already ſaid ſo much of the principles and properties of building, I hope my reader will excuſe a diſſertation on Maſonry, as the volume is already ſtretched beyond the intended ſize. For it is a noble art, and takes its date from the days of Jabel, the ſon of Lamech, who invented the firſt houſe of ſtones and trees.

Maſonry hath in its practice every definitive principle of geometry, and is not ſurpaſſed by any of the liberal arts.

The way by which Maſons value their ſolid work, is, firſt to conſider the cubical meaſurement of the ſtone, and the work as ſuperficial, reckoning nothing for what is not ſeen, and accounting all ſtone under 2 inches as ſuperficial; what exceeds this ſize or 3 inches, they reckon as ſolid meaſure.

For

	S.	d.
For key and ashler fronts, of Portland-stone, the masters charge per foot superficial ——	1	6
Surveyors allow from 1*s.* 3*d.* to	1	6
Besides measuring the solidity of the key-stones, or bonds, which go through the wall, and are charged per foot cube ——	3	9
The value of materials to a foot of key and ashler work, considering the sawing and veins which are often detrimental in the opening of a block of stone, that cannot be seen before, is worth with materials for setting, per foot superficial 9*d.* labour to squaring, rubbing, fitting, &c. is worth 6*d.* the price therefore allowed by surveyors is not in the least exorbitant at ——	1	6
Plain-work, such as curbs to iron-rails, &c. are charged at per foot superficial ——	1	0
The stone at per foot cube ——	3	0
Houses for Iron bars, cut in ditto, at per piece —— ——	0	2
Portland astragal steps are worth per foot superficial ——	1	0
The solidity of the stone as before.		
Ditto plain steps, per foot superficial	0	6
Portland coping, a foot wide, per foot run —— ——	1	10

	S.	*d.*
Mouldings of Portland-ſtone, of all ſorts, at per foot ſuperficial	1	7
Circular ditto ——	1	9
The ſtone meaſured as ſolid.		
Slips and mantles to chimnies, of Portland ſtone, are worth at per foot ſuperficial ——	1	0
Ditto, ſuperficial moulding to chimnies with ſtone, per foot	1	8

	£.	*s.*	*d.*
Portland ſlabs at per foot	0	1	0
Portland paving at per foot ſuperficial ——	0	1	6
The ſhafts of columns, of Portland ſtone, per foot ſuperficial	0	1	2
Baſes and caps to ditto —	0	3	0
Ditto columns fluted, and cabled of ſtone, labour only	0	1	9
The ſtone valued as before.			
Dorick entablatures of ſtone at per foot ſuperficial ——	0	5	6
Carving the capitals of Corinthian and compoſite orders at per foot ſuperficial ——	0	11	0
Italian marble at per foot cube	1	1	0
Plain work on ditto, as ſlips and mantles at per foot —	0	4	0
Slabs of ditto at ——	0	4	6
Dove marble in ſlabs at per foot	0	5	0
Mouldings of Chimney-pieces, &c. of any ſort of Marble at per foot			

ſuper-

	£.	s.	d.
superficial, from 3*s.* 6*d.* to	0	5	0
The marble valued extra.			
Marble, of different sorts, must be valued according to its quality, and is from 1*l.* 1*s.* per foot cube to —	7	0	0
Small mouldings of marble at per foot run, from 6*d.* to	0	1	0
Portland geometry steps are worth per foot superficial with setting	0	10	0
The stone for these must be valued at per foot —	0	3	6
On account of the variety of blocks that must be opened before they can be all got sound.			
Fire-stone covings with materials at per foot superficial —	0	1	2
Ditto in hearths per ditto —	0	1	1
Purbeck steps, as per foot run with stone — —	0	2	6
Purbeck paving in random-courses, at per foot —	0	0	7½
Old purbeck paving at per foot squared and new laid	0	0	2

The reader may perhaps wonder why I have not proceeded in masonry with the value and labour as in other work. I own it was my intent, but hearing of the laudable design now on foot of the masters raising the mens' wages three shillings per week, I therefore made the digression, knowing well that

their prices will not be in the leaſt extravagant when that is put in execution; I hope, therefore, as my whole motive is deſigned for the benefit of mankind, I ſhall be freed from all aſperſions in the above particular, by deviating from my general plan.

LECTURE LIX.

OF ESTIMATING IN GENERAL.

IT is almoſt unneceſſary to mention eſtimating in general, as I have been ſo particular in all the component parts of a building, which might by the learner be eaſily put or compiled together; however, to prevent every argument that may be offered, touching my neglect, I ſhall propoſe the ſimpleſt and moſt conciſe method in my power, that the learner may have no doubt of my fully acquieſcing in every particular of my propoſals, as well as of my ardency to ſerve him in every article that occurs to my memory.

Many ſurveyors have, or propoſe methods for eſtimating, by knowing the exterior dimenſions of a building, that is, gueſſing at the expence by the number of ſquares the houſe contains; but this is a very uncertain rule, and can never be followed with any degree of certainty, unleſs all buildings were finiſhed in the ſame manner, and conſiſted of no other variations than the ſize of the ſtructure; in ſuch a caſe a proper criterion might

be formed; but, as this never can happen, it is obvious that any examples of this nature laid down can only (like the artist, who pretends to the world, he hath a knowledge adequate to the uncertain changes of fortune in the calculation of lotteries) amuse, without the least benefit or advantage.

The only and general rule required in estimating a building, is, to be well apprised of the intent, both respecting the size of every part and particular, as well as the manner of execution; without a just notion of these principles, the greatest judge in nature can only guess at the expence; these things being fixed, the drawings will point out the size of every part, and the prices before mentioned, applied to every particular, according to the different dimensions, will form a near certainty for the whole.

If the learner have no drawings given, and only an idea propounded by the gentleman, what sort of a structure he would choose, and what expence he has settled within himself, that it should be finished after such and such a manner; let him first make a drawing of the plan and elevation (having previously examined the ground for the consequence of the under-filings) by which he will be able to come at the expence of the piling, planking, &c. if any be required; let him proceed then to take the value of the foundation, such as digging and carrying away the earth, next the brick-work, stone, &c. in the foundation,

 which

which are eaſily calculated, as I have before obſerved, according to the height of the building; then the expence of the brick-work only, in the baſement ſtory, is to be conſidered, with the outward and inward walls, the vaults, ceſs-pools, &c. next the brick-work in the firſt ſtory, or ground-floor; and ſo from ſtory to ſtory, to the top of the edifice, topping of chimnies, &c. with all the arches, tiling, and every other incident in bricklayers work.

Secondly, according to the ſize of the houſe, let him calculate the ſcantlings of the different timbers in every ſtory for the floors, as well as the lintels, wood-bricks, diſcharging-pieces, bond-timbers, &c. what is meaſured cubical, and what by the ſquare, as well as door-caſes, centres, both for vaults, openings, and apertures, not omitting the trimmers, whether arched or coach-headed, roofing, plates, tie-beams; guttering, boarding, rafters-feet, or any vacuum, where a piece of timber may be required.

Thirdly, the ſaſh-frames and ſaſhes, throughout the whole houſe.

Fourthly, the covering, whether lead, ſlate, or tile, &c.

Fifthly, the joiners work in every room, on every floor, the quality as well as quantity of materials, not forgetting the furring of walls, floors, &c. bracketing to cornices, glue, nails, and every other incident: likewiſe, the ſtairs in every reſpect and part, according to their bearings, whether with or

without

without carriages; nails, ſcrews, glue, templets, cylinders, &c. the caſualty of removing lumber and other incidents, which may retard the progreſs of his practice.

Sixthly, the plaſterers-work after the ſame manner in every room, with the gentleman's propoſals of ornaments, decorations, &c. making allowances for the inconveniences that generally attend the progreſs of the work, by ſcaffolding, &c.

Seventhly, the maſons work both without and within, ſuch as ſteps, aſhlers, facios, coping quoins, ruſticks, pavings, floors, hearths, jambs, mantles, coverings, caps, carvings, &c. all according to their different ſize and value; omitting nothing in this buſineſs more than the reſt.

Eighthly, the painters work all throughout the houſe; every floor ſeparate, and let every part and portion that hath variations be ſtrictly nominated: the number of times required to be done over, with obſervations of fronts, and other work that is paid by the foot, whether run or ſuperficial.

Ninthly, the glaſiers work in every reſpect and part the ſame as in other branches.

Tenthly, the carvers work alſo in every article, which muſt be moſt ſtrictly conſidered in every point, becauſe of the great expence attending this beautiful branch.

Eleventhly, the plumbers work, both touching the capping of cornices, fronts, facios, gutters, hips, vallies, fixtures, pipes for ſuillage,

ſuillage, pumps, drains, water-cloſets, &c. ſoldering and every other incident required.

The ſame of ſmiths work, pavers, &c. which will cauſe any expence.

When theſe matters are all well noticed, ſum up the whole, to anſwer the ſketch given; if you run above the ſtipulated price, ſuch contractions in the mode of finiſhing muſt be made as will reduce your plan to the gentleman's propoſals, if he will not be otherwiſe reconciled to what the purport of his intention amount to.

The beſt and moſt ſure way to be perfect, and that to a ſtrict nicety in every particular, is to make drawings of every room and part with the ornaments prefixed, as well as the ſection, plan, and elevation of the whole: alſo, mark every room, and every branch to each apartment or floor; and in ſumming up the whole, take care to allow a ſufficiency for caſualties, that in the execution you may not greatly exceed the ſtipulated ſum, and thereby incur the gentleman's diſpleaſure.

LECTURE LX.

SCHEDULE OF PRICES TO TASK-MASTERS.

Of Carpenter's Taſk Work.

	S.	*d.*
KING-poſt roofs with purlines &c. and fixing on the irons at per ſquare — —	9	0
Ditto common roofs per ſquare	6	6

Bridged

	S.	d.
Bridged floors, with binding joifts included, at per fquare —	8	o
Common naked floors per fquare	5	6
Cieling ditto per fquare —	6	6
Truffed partitions —	5	6
Common partitions per fquare	4	6
Plates, bond-timbers, difcharging pieces, lintels, &c. at per hundred feet run —	3	o
Centring to vaults rough —	4	6
If groined —	5	6
Centres to apertures at per foot	o	1¾
Bridged-gutters at per foot fuperficial	o	3
Ditto vally-boards per foot	o	1½
All framing in a building may be taken together at 4*d*. per foot cube tafk-work.		
Rafters-feet and eaves board per foot run — —	o	1¾
Framing the carcafes of houfes per fquare — —	6	6
Door-cafes per foot —	o	1½
If rabbited and beaded —	o	2
Bracketing to plafter cornices run	o	1½
Clean dowelled floors per fquare	17	o
Second beft ditto —	15	o
Straight joint ditto of board	8	o
Ditto with battins —	10	o
Folding-floors per fquare —	6	o
Furring-joifts per fquare —	1	2
Lifting-boards per lift —	o	o½

Doors

	S.	d.
Doors ovlo and flat on both ſides per foot — —	o	6
Ditto ſtuck on one ſide ſquare back	o	$3\frac{1}{2}$
Doors with fancy-mouldings quirked per foot — —	o	7
Aſtragal-mouldings on the pannels to ditto at per foot run —	o	2
All window-ſhutters per foot ovlo, and flat, ſquare behind, hung ſingle	o	6
Ditto hung double ——	o	7
If ſtuck with a quirk moulding.		
Bead and fluſh behind, and hung double, are worth per foot	o	10
Aſtragal-mouldings on the pannels to ditto — —	o	2
Back-ſhutters framed ſquare	o	$3\frac{1}{2}$
If bead and but hung double	o	$4\frac{1}{2}$
Plain clamped back-ſhutters per foot	o	$2\frac{1}{2}$
Framing linings ——	o	3
Doors bead and fluſh, &c. both ſides, per foot ——	o	8
Ditto beaded on one ſide —	o	5
Bead and fluſh ſhutters to outſide work	o	$5\frac{1}{2}$
Saſhes and frames with oak-caſings, ſoils, beads, &c. together	o	7
Ditto with mahogany ſaſhes	o	$8\frac{1}{2}$
Fir ſaſhes and frames together per foot — —	o	5
Venetian and Palladian window-faames and ſaſhes at per foot	2	o
Mouldings of all ſorts at per foot	o	6
Columns at per foot ——	o	10

3 Pilaſters

	S.	d.
Pilasters ditto ——	0	6
Fluting columns, or pilasters, the flutes at per foot run ——	0	$1\frac{1}{2}$
If cabled as far as the length of ditto	0	$2\frac{1}{2}$
Dorick friezes at per foot superficial	0	10
Dorick blocks plain per foot	0	6
Raking ditto ——	0	8
Ditto with enrichments ——	2	6
Frets 6 inches broad, per foot	2	0
Small frets per foot run ——	0	6
Fluting of facios per foot run	0	5
Friezes fluted and bead per foot run; the plane of the frieze at per foot superficial ——	0	$2\frac{1}{2}$
The beads and flutes run at	0	$1\frac{1}{2}$
The method of measuring ditto, is to take the length of one flute, and multiply the number of flutes in the frieze.		
Terms to chimney-pieces per foot superficial ——	0	9
Gluing up Ionick caps for carvers at per piece ——	2	0
Corinthian ditto per foot superficial	0	6
Dado per yard ——	1	6
Torus skirting per foot —	0	$2\frac{1}{2}$
Up stair-cases double measure.		
Horse-plane courses per foot run	0	$1\frac{1}{2}$
O-gees per foot run ——	0	$0\frac{3}{4}$

Dog-

	£.	s.	d.
Dog-legged ſtairs at per ſtory.	1	8	0
Bracket ditto per foot ſuperficial	0	0	$4\frac{1}{2}$
Ditto with clean ſteps —	0	0	5
Newels at per foot run —	0	0	4
Strings at per foot ſuperficial	0	0	6
Balluſters per piece —	0	0	3
If dove-tailed —	0	0	4
Geometry-ſtairs moulded underneath as the bracket, per foot	0	0	9
Or per ſtep —	0	10	6
Steps hung in the wall at per foot	0	0	8
The ſtring at per foot, if upon a Circular or oval plan	0	1	6

There is a method of making geometry-ſtairs without a ſtring, though they be not moulded underneath the ſteps. This is done by mitring the bracket, and fixing it to the end of every ſtep, before they are put up, and leaving them long enough to exceed the width of the under-ſide of the ſtep, ſo as that the ſucceeding one ſhall take and lie upon this, in regular form all the way to the top; after they are up, you may ſhoot ſtraight the under edge of the brackets, which will appear like the under edge of a ſtring; you may alſo put up a fillet on the inſide, which will bear the ends of the laths, and be a kind of ſtiffening to the brackets, or artificial ſtring.

Theſe are much the cheapeſt of all ſtairs, and may be done to any plan, with a good

good appearance, by fixing a neat astragal moulding to the lower edge, just under the nosings.

The learner is to observe, that these brackets need not be longer than will be adequate to receive the furrings, and the laths and plaster. The reader will excuse my making this digression, as I had omitted mentioning these sort of stairs in their proper place; however, I will shelter my neglect under the old proverb, that it is better late than never.

	S.	*d.*
These sort of stairs are worth per foot, labour only, when hung in the wall ——	0	7½
Plain brackets to stairs per piece	0	6
Circular ditto ——	1	0
Mahogany hand-rails to stairs to circular plans, glued in thicknesses, are worth at per foot superficial	7	0
The cylinder, either done by day, or allowed per foot, the run of the circular part of the rail —	0	4
All twists to scrolls ——	5	0
Straight rail of mahogany —	1	3
Ramps double measure, or —	2	6
Deal straight rail ——	1	0
Twist to ditto ——	4	0
Shelves per foot ——	0	3½
Linings of all sorts —— ——	0	2½
All plain linings to door-cases	0	3

LEC-

LECTURE LXI.

OF BRICKLAYERS TASK-WORK.

THE master to find all materials and ſcaffolding.

	£.	s.	d.
Common brick-work per rod	1	3	0
Chamber arches, rhombed, gauged, and ſet, per foot —	0	1	0
Circular ditto — —	0	1	2
Ditto to a niche per foot —	0	3	6
A circular arch upon a circular plan double meaſure —	0	2	0
Brick cornices per foot ſuperficial	0	2	6
Plain tiling per ſquare —	0	5	0
Ditto pan-tiling pointed —	0	5	0

LECTURE LXII.

OF PLASTERERS TASK-WORK.

	S.	d.
ALL cielings, per yard —	0	5
Ditto walls with three coats on laths —	0	5
Ditto two coats floated —	0	4
Walls floated per yard —	0	3½
Stucco per yard —	0	8
All plain cornices per foot	0	4½
Ditto fully enriched —	1	0
Common block cornices per foot	0	8
Dentil ditto — —	0	7

LEC-

LECTURE LXIII.

OF MASONS TASK-WORK.

SOMETIMES masons set their men task-work, though it is but seldom; I shall therefore mention two or three prices in particular cases, and which may be a better method of calculation than what they generally go by in task-work.

The masons method of taking work is by the piece in many jobs, as frontispieces, &c. but I think it rather an irregular mode of proceeding, without one advantage to recommend it.

Frontispieces of the Dorick order, when done by the piece, may be charged from 10*l.* to 12 guineas, according to the enrichments which are upon them; but the best way is to measure them by the foot superficial, and value the different works after the following prices:

	S.	*d.*
The columns at per foot superficial	0	8
Bases and capitals per ditto	2	9
Fluting and cabling columns in Portland-stone, the run of the flutes at per foot ———	0	5
All mouldings at per foot	0	$7\frac{1}{2}$
Friezes to Dorick cornices per foot	5	0
Mutules level at per piece	4	0
Raking ditto ———	4	6

	S.	d.
All the plain work per foot	0	5
Portland ſteps per foot run	0	7
Geometry ditto, and ſet-off, per foot run ———	0	8
Paving with Portland ſtone, per 100 feet, from 5*s*. to ——	8	0
Purbeck in random-courſes per 100	4	6
Old Purbeck taken up new ſquared, and re-laid, at per 100 feet	3	9
Key and aſhler fronts per foot	0	4
Holes cut for Iron palliſades per piece	0	1½

As ſeldom any other branches are done taſk-work, I beg the reader, when he hath other ſorts of work, and not thoſe above mentioned, to have recourſe to the other parts of the book, where the labour required is proved, and get as much as he can for them.

EXPLA-

EXPLANATION *of* PLATE A.

FIGURE A represents the ground plan of a ſtaircaſe of circular diſpoſition, from the mode of executing which every difficulty may be gathered or ſuppoſed, that can occur in any ſimilar circumſtance.

Figure C, the templet, ſaddle, or cylinder, on which the hand-rail is to be glued, in ſuch manner as is deſcribed in my lecture on weith-rails.

B repreſents the profile of the ſteps, both in the height and circular part, with the hand-rail ſtretched out upon them. The ſhadowed part in figure A ſhews the diameter of the cylinder, and by drawing the perpendicular lines from the noſings of the ſteps, and joining them upon the cylinder, as is marked by the dotted lines, you will have the ſectional line of the rail when laid upon the cylinder. Obſerve the places where the want of diſtention, or the contraction of the covers to the winders againſt the circular part, leaves the two obtuſe angles; theſe muſt be ſoftened or rendered eaſy by interſection of lines, as is ſhewn by figure M. Take notice alſo, that theſe are the places I have ſo particularly mentioned in my lecture on thoſe ſorts of rails, to leave wood enough upon the breadth of the fineer for the ſide of the rail, as every thickneſs will gradually gather.

Figure D is the plan of a ſcroll, on which are ſhewn the pieces of wood to be glued to form the riſing of the twiſt, which may be cut one way to the ſhape of the dotted lines in the plan before they be glued together.

The figures E, F, and G are thoſe pieces to be glued to each other in the following manner: H repreſents the lower part of the ſtraight rail which forms part of the twiſt; as in figure H, draw the line *a c*, then fix your dividers in *c*, draw the arch line *a b*, which divide into four equal parts, and then draw lines as to the centre *c*, which will ſhew how much the twiſt falls in each reſpective piece: from hence you may gain the maxim of exactly matching the grain of the wood, that when they are all united by glue and worked, they may appear as if the whole ſcroll, ſtraight rail and twiſt, were cut out of one entire piece; next draw the arched line in E, and transfer from 4 to 3 in H, to *d* in E, which will ſhew how much the twiſt falls in that piece. Then take from 4 to 2 in H, and transfer to *e* in F; this will ſhew the fall in the ſecond piece. Laſtly, take from 4 to 1 in H, and transfer to *f* in G, which is the laſt fall, and muſt be glued to the level piece in the eye as 6 in figure D; when thus much is done, take the different bevils from the pitch-board K, and apply them to each piece at the inſide of the ſcroll, as 1 & 1, 2 & 2, 3 & 3, 4 & 4, and keep them fair at the inſide as you glue them together, which will guide

guide the rail to a proper fall, and anſwer when elevated directly to the ground plan. The bevils being given both ways, after you have ſquared the outſide of the rail, bend your mould or templet round, as deſcribed in plate B in figure E, which will ſhew how much ſuperfluous wood muſt be taken off the back of the rail. I think it unneceſſary to ſay more, as inſpection and a little practice will render this matter plain to any capacity.

The next thing is the raking-mould in figure I, to draw which lay down one quarter of the ground plan of your ſcroll, as at *g* in figure I, then divide the under-edge of the pitch-board into any number of parts, which continue from the raking-line to the outſide of the rail as in *h i*, *l k*, &c, to the bottom of the pitch-board.

Next take from *m* to *i* in your dividers, and transfer them to *h n*; take alſo *p k* and transfer to *l o*, and ſo on to all the reſt; and if you be doing this at large put in brads at each point, and bend round a lath ſo as to form the ouſide, then proceed as before for the inſide, and your mould will be complete and of direct length, anſwerable to the ground plan.

Though it be neceſſary to point out theſe things to the learner in order to ſatisfy him as to the priſtine elements of this piece of workmanſhip, yet I cannot help obſerving, that a raking-mould is of very little uſe to a perſon who has any idea of the matter, as it is a ſtanding maxim with me, that the man who

Figure D is the plan of a ſcroll, on which are ſhewn the pieces of wood to be glued to form the riſing of the twiſt, which may be cut one way to the ſhape of the dotted lines in the plan before they be glued together.

The figures E, F, and G are thoſe pieces to be glued to each other in the following manner: H repreſents the lower part of the ſtraight rail which forms part of the twiſt; as in figure H, draw the line *a c*, then fix your dividers in *c*, draw the arch line *a b*, which divide into four equal parts, and then draw lines as to the centre *c*, which will ſhew how much the twiſt falls in each reſpective piece: from hence you may gain the maxim of exactly matching the grain of the wood, that when they are all united by glue and worked, they may appear as if the whole ſcroll, ſtraight rail and twiſt, were cut out of one entire piece; next draw the arched line in E, and transfer from 4 to 3 in H, to *d* in E, which will ſhew how much the twiſt falls in that piece. Then take from 4 to 2 in H, and transfer to *e* in F; this will ſhew the fall in the ſecond piece. Laſtly, take from 4 to 1 in H, and transfer to *f* in G, which is the laſt fall, and muſt be glued to the level piece in the eye as 6 in figure D; when thus much is done, take the different bevils from the pitch-board K, and apply them to each piece at the inſide of the ſcroll, as 1 & 1, 2 & 2, 3 & 3, 4 & 4, and keep them fair at the inſide as you glue them together, which will

guide

guide the rail to a proper fall, and anſwer when elevated directly to the ground plan. The bevils being given both ways, after you have ſquared the outſide of the rail, bend your mould or templet round, as deſcribed in plate B in figure E, which will ſhew how much ſuperfluous wood muſt be taken off the back of the rail. I think it unneceſſary to ſay more, as inſpection and a little practice will render this matter plain to any capacity.

The next thing is the raking-mould in figure I, to draw which lay down one quarter of the ground plan of your ſcroll, as at *g* in figure I, then divide the under-edge of the pitch-board into any number of parts, which continue from the raking-line to the outſide of the rail as in *h i*, *l k*, &c, to the bottom of the pitch-board.

Next take from *m* to *i* in your dividers, and transfer them to *h n*; take alſo *p k* and transfer to *l o*, and ſo on to all the reſt; and if you be doing this at large put in brads at each point, and bend round a lath ſo as to form the ouſide, then proceed as before for the inſide, and your mould will be complete and of direct length, anſwerable to the ground plan.

Though it be neceſſary to point out theſe things to the learner in order to ſatisfy him as to the priſtine elements of this piece of workmanſhip, yet I cannot help obſerving, that a raking-mould is of very little uſe to a perſon who has any idea of the matter, as it is a ſtanding maxim with me, that the man who

Figure D is the plan of a ſcroll, on which are ſhewn the pieces of wood to be glued to form the riſing of the twiſt, which may be cut one way to the ſhape of the dotted lines in the plan before they be glued together.

The figures E, F, and G are thoſe pieces to be glued to each other in the following manner: H repreſents the lower part of the ſtraight rail which forms part of the twiſt; as in figure H, draw the line *a c*, then fix your dividers in *c*, draw the arch line *a b*, which divide into four equal parts, and then draw lines as to the centre *c*, which will ſhew how much the twiſt falls in each reſpective piece: from hence you may gain the maxim of exactly matching the grain of the wood, that when they are all united by glue and worked, they may appear as if the whole ſcroll, ſtraight rail and twiſt, were cut out of one entire piece; next draw the arched line in E, and transfer from 4 to 3 in H, to *d* in E, which will ſhew how much the twiſt falls in that piece. Then take from 4 to 2 in H, and transfer to *e* in F; this will ſhew the fall in the ſecond piece. Laſtly, take from 4 to 1 in H, and transfer to *f* in G, which is the laſt fall, and muſt be glued to the level piece in the eye as 6 in figure D; when thus much is done, take the different bevils from the pitch-board K, and apply them to each piece at the inſide of the ſcroll, as 1 & 1, 2 & 2, 3 & 3, 4 & 4, and keep them fair at the inſide as you glue them together, which will

guide

guide the rail to a proper fall, and anſwer when elevated directly to the ground plan. The bevils being given both ways, after you have ſquared the outſide of the rail, bend your mould or templet round, as deſcribed in plate B in figure E, which will ſhew how much ſuperfluous wood muſt be taken off the back of the rail. I think it unneceſſary to ſay more, as inſpection and a little practice will render this matter plain to any capacity.

The next thing is the raking-mould in figure I, to draw which lay down one quarter of the ground plan of your ſcroll, as at *g* in figure I, then divide the under-edge of the pitch-board into any number of parts, which continue from the raking-line to the outſide of the rail as in *h i*, *l k*, &c, to the bottom of the pitch-board.

Next take from *m* to *i* in your dividers, and transfer them to *h n*; take alſo *p k* and transfer to *l o*, and ſo on to all the reſt; and if you be doing this at large put in brads at each point, and bend round a lath ſo as to form the ouſide, then proceed as before for the inſide, and your mould will be complete and of direct length, anſwerable to the ground plan.

Though it be neceſſary to point out theſe things to the learner in order to ſatisfy him as to the priſtine elements of this piece of workmanſhip, yet I cannot help obſerving, that a raking-mould is of very little uſe to a perſon who has any idea of the matter, as it is a ſtanding maxim with me, that the man who

has the best eye, will ever be the first man at forming either a scroll or twist, or any other difficult point in weith-rails.

A brief Definition *of* Plate B.

FIGURE A in plate B is the plan of a regular staircase upon a square opening. B in ditto shews the section of the two flights, with the manner of fixing the strings, carriages, leading-pieces, newels, &c. and how to find the knees, and strike out the ramps.

To find the knees and ramps: First draw a line to touch the nosings of the steps, as the dotted lines, then from that line to the back of your rail set off 2 feet 1 inch, or 2 feet 2 inches square, from the raking of the steps, as is shewn in the plate. Next, continue that line to the front of the first newel, as at *a*; likewise to the first newel upon the half-pace, as at *b*, then take the distance *a c* upon the first newel, and transfer it to *b d*; afterwards, apply the rise of one step above *d*, which will give the height of the ramp.

To find the centre for striking the ramp; First, continue the level line upon the top of the knee at pleasure, as at *e*, then mark where the raking-line of the rail touches the front of the newel as at *f*, on which place fix one point of your compasses and extend the other point to *g*, describe the arch *h* which shews the bounds of the straight rail, there place

your

your ſquare, and draw a line to meet at *e*, which is the centre for ſtriking the ramp.

How to draw a Scroll, as in Figure C.

If the learner cannot execute this by Lecture XL, let him obſerve the following: Having drawn a large circle, as in C, equal to the width of two ſteps, draw an inner one equal to the ſize of the rail with the mouldings; then divide the large circle into eight equal parts, ſo as to ſtrike one eight part at one time, next draw the diagonal *b c*, and having fixed your dividers in *c*, deſcribe the arc *dc*, which arch line divide into 8 parts, and from the centre draw them through into the line *d b*, which forms the ſcale to diminiſh the ſcroll by in the following order: Firſt ſet your dividers from *b* to *f* upon the ſcale, and transfer it to *n o* upon the great circle, which is the firſt eighth part; ſet them then from *b* to *g*, and transfer to *p q*, then *b h* to *r s*, and ſo on till you come to *z*; next ſet your compaſſes in the centre *a*, extend the other point to *f* on the ſcale, and with that diſtance ſet the point upon *o*, then upon *c*, and make a mark upon the eye where they fall, which will be the centre for deſcribing the firſt eighth part from *e* to *o*, after this proceed with the next in the ſame manner, ſetting your compaſſes from the centre *a* to *g* upon the ſcale; draw the ſweep from *o* to *q*, and ſo from *q* to *s* in the ſame manner till you

have described the whole. The inner circle must be drawn in the same manner, and from the same centres, only must stop at each central line and not be contiued to the dotted lines. A little inspection it is hoped will render this very familiar.

D is the pitch-board, on which are right lines, as at E, for the falling of the twist; observe in *c* where the twist begins, as at 10, and ends at 9, which girt with a line, or divide into parts with your dividers, transfer them with a straight line as at *b a* in D; then take the pitch-board and apply to *a*, as in the figure, afterward divide the raking-line of the pitch-board from *d* to *c* in any number of parts, and from *e* to *b* in the like number, and draw the intersections of right lines, which will form the curve for the fall of the twist. When the outside of your rail is made to stand directly over your ground plan, apply the mould *b* to 9 in plate C, which will extend to *c* round the rail, the mark by the edge, and take off the wood square from the outside; afterwards gauge for the width and depth, and when cut away properly your work will be complete.

TREATISE

OF

ARITHMETICK:

Adapted to and proposed for Students in the

BUILDING BRANCH.

A TREATISE OF ARITHMETICK:

LECTURE LXIV.

INTRODUCTION.

ARITHMETICK is a Greek word, and imports an art or ſcience that teaches the uſe and properties of figures, or the right art of numbering and denoting any given quantity with proper characters, and to expreſs them by words, which is called Notation. There are many kinds of Notation by which quantity is expreſſed, but what I mean in this lecture to treat of, is figural, or the manner of expreſſing quantities by the ten Arabick characters, viz. 1, 2, 3, 4, 5, 6, 7, 8, 9, 0.

Arithmetick is divided into three parts, two of which are properly called natural, and the third artificial;

The

The first is that kind of Arithmetick which is called Vulgar, and is the doctrine of whole numbers, and the most plain and easy, because every unit, or one (which is called an integer) denotes or signifies one entire thing, or quantity, of some kind of species; as a stone, a rule, &c.

The second, is the doctrine of broken quantities, or parts of units, or integers, which is called Vulgar-fractions; and wherein the unit, or integer, is divided into a number of even or uneven parts: as for example,

If a foot be the given or proposed unit, or integer, and be divided into twelve inches, then one inch becomes a fraction or twelfth part; two inches one-sixth, three-inches one-fourth part thereof.

This part of arithmetick may be considered either as pure, consisting of fractional parts only, each less than an unit; such as quarters, halves, &c. or of integers and fractional parts intermixed; as one and a half; two and one third part of one, &c.

The third part, which is called Artificial, is also called Decimal-arithmetick, which is an artificial method of working fractions and broken numbers, in a different, and (by some thought) much easier way than that of Vulgar-fractions.

Decimals take their name from the Latin *Decem*, or ten, into which every integer is supposed to be divided; and in many cases every

sub-division is again sub-divided into ten lesser parts, &c. Suppose one foot in length to be an integer, or unit given, and let it be divided into ten equal parts, we then say the foot is decimally divided; and if every tenth part be decimally divided again in the like manner, then the foot will be divided into one hundred parts, and is said to be centesimally divided.

LECTURE LXV.

OF NUMERATION.

NUMERATION is accounted the first part of Arithmetick, and is to know how to read a sum of figures expressed in writing; or to write down any sum to be expressed; to the doing of which there are four things necessary; first, to know the number, which is nine; secondly their shapes, which are 1, 2, 3, 4, 5, 6, 7, 8, 9, of which the first toward the left hand ever signifieth one; the second two, the third three, &c. thirdly to know the value of their places; lastly, how their proper signification is attained thereby.

The value of their places is thus: when two, three, or more figures stand in one sum, that is, without any point, line, or comma betwixt them, as 321, that place next the right-hand where the figure 1 standeth, is called the place of unity, or units, and the figure 1 standeth in that place for 1 only, and the figure

figure 2, when it is found in that firſt place, ſtands only for 2, and ſo of all the reſt.

But in the ſum 321, above expreſſed the figure 2 in the ſecond place, and every place, contains the value of that place before towards the right hand ten times; therefore the figure 2 doth not in this ſecond place ſignify 2, but ten times 2, that is 20; and ſo the figure of 3, if it had been in that ſecond place, would have ſignified ten times 3, that is, 30, but being here in the third place, it ſignifies ten times 30, that is, 300, and ſo the whole ſum 321 is to be read three hundred and twenty one.

It is hereby ſeen how their proper ſignifications, which were three, two, and one, are altered by being thus placed, and the ſum, which would but have been ſix, is three hundred twenty and one.

In like ſort, if there had been more places, as ſeven, the value is quite through increaſed ten times, by being a place more towards the left hand, as in the ſum 1111111; the figure 1 in the ſecond place ſtands for ten times one, that is, ten; in the third for ten times ten, which is one hundred; in the fourth for ten hundred, which is called a thouſand; in the fifth for ten thouſand; in the ſixth for ten times ten thouſand, which is an hundred thouſand; in the laſt, or ſeventh place, for ten hundred thouſand, which is called a million; and ſo on, if there were more places. Ob-

ſerve

ſerve the ſame order to infinity beyond all earthly value.

Now, to read this readily, mark a prick over the place of unity; another the third from it, and over every third, ſtill towards the left hand; for ſo thoſe points will be over the places of units, thouſands, and millions; and then beginning at the laſt figure that is at the left hand, read one million, and becauſe the three following towards the right ſignify properly one hundred and eleven, but the prick belonging to them lying in the place of thouſands, call it one hundred and eleven thouſand; and the three remaining being under the point over unity, ſignify one hundred and eleven; but all three points, read together in one ſum, make one million one hundred and eleven thouſand one hundred and eleven.

In like manner, if this number 87654352, were given to be read (according to the former direction) make pricks over every third figure, beginning with the firſt figure towards the right hand (which is the place of unity) and then your number will ſtand thus, 87654352; then for the ready reading of them (becauſe the third prick ſignifies millions) call all the figures toward the left hand from that prick, millions, which in the example are 8 and 7, begin and ſay 87 millions 654 thouſand 352, which at length are eighty ſeven millions ſix hundred and fifty four thouſand

ſand

ſand three hundred and fifty two; and ſo of any other number.

LECTURE LXVI.

OF ADDITION.

ADDITION is the gathering or collecting of two or more ſums, either of one or of divers denominators, into one ſum, which is called the aggregate, total, or groſs ſum. In addition of numbers of one denomination, the order is to ſet the numbers to be added, one directly under the other; that is to ſay, units under units, tens under tens, hundreds under hundreds, thouſands under thouſands.

RULE.

Having placed your numbers to be added in due order one under another, draw a line under them, and begin at the lowermoſt figure toward your right hand, and add that to the next figure above, and the ſum of them to the next figure above that, proceeding in this order till you have added the line together; which when done, conſider how many tens are contained in that line; and for every ten carry one to the next column; but if there be any odd digits, you muſt ſet them down beneath the ſtroke, juſt under the line you have added together; having thus finiſhed the addition of one line, proceed to the next; and from thence to the third, and ſo forward be there never ſo many. The following will make this plain.

Ex-

Example the first, of whole Numbers.

Let the several sums given to be added be 9874, 6436, 1423, 6788; having thus placed them under one another, as in the margin, draw a line under them; then begin your addition to the lowermost figure to the right hand, say 8 and 3 is eleven, and 6 is seventeen, and 4 is twenty-one, there is 2 tens and 1 remaining, I place the 1 under the line, and carry the two tens to the next row, saying, 2 which I carry and 8 is ten, and 2 is twelve, and 3 is fifteen, and 7 is twenty-two, in which row there are two tens to carry, and 2 remains which I place as before; again proceed to the next column, saying 2 and 7 is nine, and 4 is thirteen, and 4 is seventeen, and 8 is twenty-five, set down five and carry two again to the next, saying, two I carry and 6 is eight, and 1 is nine, and 6 is fifteen, and 9 is twenty-four, which set down under the margin; so the aggregate or gross sum is twenty-four thousand five hundred and twenty-one.

9874
6436
1423
6788
24521

In the addition of divers denominations, this is to be observed, viz. place all the numbers of the same denomination one directly under another, as inches under inches, feet under feet, yards under yards, squares under squares;

ſquares; then draw a line under them, and begin your addition with the ſmalleſt number or leaſt denomination firſt, always obſerving how many times the next greater denomination is contained in that leaſt; and for every time carry one unit to the next place, as before you did the tens, taking care to ſet down the remains if any be; then add the next denomination together, taking care how often the next greater denomination is contained in that, and ſo proceed be they ever ſo many from parts to inches, inches to feet, feet to yards, yards to ſquares, rods, poles, or perches.

As all the parts of addition are built upon the ſame reaſon, ſo the method of pointing may ſerve as a general rule, when any denomination is to be added, and this may be done without defacing the figures.

EXAMPLES.

Let the ſeveral denominations to be added be ſet down as in the margin, ſuppoſe the work of different rooms done be as follows:

	Yds.	Ft.	In.
To dado on the ground floor	127	7	6
To ditto one pair of ſtairs	162	5	3
	290	3	9

Proceed and begin at the inches, ſaying, 3 and 6 is nine, which I write under the inches, and as 9 inches is leſs than a foot, you have nothing

nothing to carry to the next denomination, but ſay 5 and 7 is twelve; now as nine ſquare feet are a yard, you muſt ſet the remainder three under the denomination of feet, and carry one to the next column, ſaying, 1 and 6 is ſeven, and 2 is nine, which ſet down and ſay 1 and 1 is 2, which makes 290 yards 3 feet 9 inches.

A ſurveyor having meaſured and ſquared the different dimenſions of brick-work, ſet them down for addition as follows:

	Rods	Ft.
To foundations, vaults, &c.	6	50
The ſeveral walls in the firſt ſtory	9	80
Ditto to the ſecond —	8	43
Attick-ſtory —	6	84
Gable-ends and chimnies —	1	19
	31	4

The reader is to obſerve that a rod of brick-work is 272 and $\frac{1}{4}$, therefore he muſt prick at 272 feet; if not ſo much, ſet down the remains of feet, and add up the rods, and theſe examples may ſerve for every thing elſe of whatever denomination.

Addition of Feet and Inches.

Ft.	In.	
53	6	Note, for every 12 inches carry one to the feet.
42	7	
82	9	
178	10	

Addition of Yards Feet and Inches.

Yds.	Ft.	In.	
12	9	4	Note, as nine feet are a yard, so at every nine feet you must carry 1 to the yard as in the example.
7	4	3	
13	6	2	
34	1	9	

Addition of Lime and Sand.

	Hun.	Bags.	
Collect into one sum these several quanti-ties of lime, viz	3	14	Rule, for every 25 bushels carry one to the hundred,, which add as in-tegers.
	4	06	
	5	12	
	3	13	
	16	20	

Note, twenty-five bags, which ought each to be a bushel, is accounted one hundred of lime in London; and in many countries 30 bushels is called a load.

Of Sand.

	Loads.	Bushels.	
Collect into	27	04	Rule, for every 18
one sum these	26	15	bushels carry 1
several quanti-	29	12	to the loads, and
ties of sand.	16	18	add them as
			whole numbers.
	100	13	

Note, a load of sand is 18 heaped bushels.

Addition of Bricks.

	Loads.	Bricks.	
Note, 500	2	148	Rule, for every
bricks are a load,	6	193	500 carry 1 to
add these several	4	050	the loads, and
quantities into	7	240	add them as
one sum, viz.			whole numbers.
	20	131	

Of Timber and Plants.

	Yds.	Ft.	
Collect into	7	33	For every 50 carry
one sum the se-	8	40	one to the loads,
veral quanti-	5	23	and add them as
ties, viz.	4	12	whole numbers.
	26	08	

Note, 50 feet solid make one load.

Of Solid Yards.

Yds.	Ft.	
7	04	Note, for every 27 carry one to the yards.
2	22	
6	15	
4	13	
21	0	

Having done ſo much of addition, I ſhall conclude the lecture with this obſervation, that one load of earth is one ſolid yard.

A hundred weight of lead, nails, iron, &c. is 112 pounds; a hundred weight of deals or nails ſix ſcore or 120*lb.*

A bundle of five feet laths 100, and of 4 feet ditto 120, which ſhould be 1 inch and $\frac{1}{2}$ broad, as it is expected a bundle of laths of whatever length is to cover the ſame; for what is wanting in length is made up in number.

LEC-

LECTURE LXVII.

SUBTRACTION.

Of Feet, Inches, and Parts.

	Ft.	In.	Qr.	Ft.	In.	Qr.
From	274	7	2	364	2	4
Take	153	5	1	173	8	4
	121	2	1	190	6	0

Note, that in inches you borrow twelve.

Subtraction of Yards, Feet, and long Inches.

Yds.	Ft.	In.	Yds.	Ft.	In.
40	7	6	23	2	6
32	4	2	13	4	7
08	3	4	09	0	11

Note, as you borrow 12 at the inches, and carry one to the feet, so you borrow 3 at the feet and carry one to the yards.

Subtraction of square Yards and square Feet.

Yds.	Ft.	Yds.	Ft.
47	5	82	7
36	9	43	8
10	5	38	8

Note, here at the feet you borrow 9 and carry one to the yards, because 9 square feet make a square yard.

Sub-

Subtraction of ſolid Yards.

Yds.	Ft.		Yds.	Ft.
55	17		78	18
43	29		53	20
11	15		24	25

Here, as 27 feet is a yard ſolid, ſo you borrow 27 at feet, and carry 1 to the yards.

Of Squares of Flooring, &c.

Square	feet.		Square	feet.
94	11		26	4
13	72		19	40
80	39		6	64

Here, as 100 ſquare feet make one ſquare, ſo at the feet you borrow 100, and carry 1 to the ſquare.

As there is nothing more in ſubtraction to be obſerved than the denominations of which you borrow, I ſhall think theſe examples ſufficient, and proceed to multiplication.

LEC-

LECTURE LXVIII.

OF MULTIPLICATION.

MULTIPLICATION is that part of arithmetick which teacheth how to increase one number by another, so that the number produced by their multiplication shall contain one of the numbers multiplied, so many times as there are units contained in the other.

Multiplication may fitly be termed a compendium of addition, for that it performeth at one operation the same which to effect by addition would require many. For instance, if it were to know how many 4 times 8 is, to perform this by addition I must set four figures of 8 one under another, and by adding them together I shall find that the total will contain 32. But this by multiplication is with far more brevity, as by examples hereafter shall appear.

Before you enter upon the practice of multiplication; it is necessary to remember the product arising by the multiplication of any of the nine digits by any other of the same, as readily to know that 3 times 4 are 12, 6 times 7 are 42, 8 times 8 are 64, &c. &c.

In multiplication it is necessary to know the product of any two of the nine digits or figures; for which purpose the following table must be studied till you have it by heart.

Multiplication Table.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	16	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

In multiplication three things or terms are to be obſerved, that is to ſay, the multiplicand, the multiplier or multiplicator, and the product.

The

The multiplicand is the number to be multiplied. The multiplier is the number by which the multiplicand is multiplied. And

The product is the number which is produced by the multiplication of the multiplicator and multiplicand together.

Thus if it were required to multiply 9 by 6, here 9 is the multiplicand and 6 the multiplier, and these numbers multiplied make 54, which is the product; for 6 times 9 is 54, or 9 times 6 the same.

In multiplication it matters not which of the two numbers is the multiplicand, or which the multiplier, for the product produced by either will be the same. But the common way is to make the greater number the multiplicand, and the lesser the multiplier.

RULE I.

The numbers to be multiplied must be set one under another, viz. the multiplicand (or greater number) above, and the multiplier (or lesser number) below; the last number of the multiplier under the last figure of the multiplicand; then draw a line under them, and having learnt the preceding table by rote, multiply every number of the multiplier into every number of the multiplicand, and set the several products under the line; then having finished your multiplication, draw a line at the bottom, and add all the products together, and the sum of these pro-

products will be the general product, as by the following examples will appear.

Example the First.

Let it be required to multiply 872 by 6; first, I write down 872, the multiplicand; and under it 6, the multiplier; then under them I draw a line as in the margin; then I multiply 6 into every digit of the multiplicand, saying, 6 times 2 are twelve; place 2 under the line directly under the 6, and for the ten keep one in your mind to carry to the next figure; then I say 6 times 7 are 42, and one I carry makes 43; then set down 3, and keep 4 in your mind for the four tens to carry to the next, saying, 6 times 8 are 48, and 4 I carry make 52, which set down, and the work is done; and the product is 5232.

$$\begin{array}{r} 872 \\ 6 \\ \hline 5232 \end{array}$$

Example the Second.

Let it be required to multiply 5753 by 24; set them down as before, and proceed in the same manner, saying, 4 times 3 are 12, place 2 under the 4, and carry 1; 4 times 5 are 20, and 1 I carry makes 21; set down 1, and carry 2; then 4 times 7 are 28, and 2 I carry make 30; set down 0 and carry 3; then 4 times 5 are 20, and 3 I carry make 23, which set down also; then begin with the 2, saying, 2 times 3 are 6, which

$$\begin{array}{r} 5753 \\ 24 \\ \hline 23012 \\ 11506 \\ \hline 138072 \end{array}$$

which place under 1; then 2 times 5 are 10, ſet down an 0, and carry 1; and 2 times 7 are 14, and 1 I carry makes 15; ſet down 5, and carry 1 ſtill: then 2 times 5 are ten, and 1 I carry makes 11, which finiſhes both the digits. This done I draw a line under them, and add the two ſums together, which make 138072 as in the margin.

Examples for Practice.

43672	7643215	87462
200	4003	100
8734400	22929645	8746200
	30572860	
	30595789645	

In the firſt example I have contracted my work by placingthe two of the multiplier under the unit of the multiplicand, which ſhould always be done when the other figures to the right-hand are all cyphers. In the ſecond I make a contraſt by omitting the cyphers in the multiplier, and multiplying only by the 3 and 4; but when this is done, you muſt be careful to ſet down the firſt figure of your remains directly under the place of your multiplier. In the third example I have contracted my work by adding the number of cyphers in the multiplier to the multiplicand for the product, becauſe one neither multiplies nor divides.

Examples for Practice.

Multiplication of integers may be performed without giving any trouble to the mind, by carrying on the tens as in the firſt examples ſhewn. Mind the operation.

Multiply 97643 by 4, as in the margin; ſay 4 times 3 is 12, ſet down 12, as is obſerved in the example; then 4 times 4 is 16, ſet 1 at top next the 12 to the left hand, and 6 at the bottom under the ſecond figure in the multiplicand; then 4 times 6 is 24, which ſet	97643 4 ——— 322112 6846 ——— 390572

down, 2, at the top and 4 at the bottom; then 4 times 7 is 28, which ſet down as the reſt; then 4 times 9 is 36, which ſet down as before, and add the two ſums together, and you will have the true product required. And this example will ſerve, let the multiplier conſiſt of any number of figures whatſoever.

More

More Examples for Practice.

Let 53568 be multiplied by 24 as under.	Multiply 83647 by 33.
53568	83647
24	33
212232	201121
0204	4982
101116	201121
0602	4982
1285632	2760351

Note, theſe examples are the ſame as the firſt, only twice repeated; obſerve, when the product of any figure is leſs than ten, place a cypher before it to the left as below, by the product of 2 in the firſt figure; if after it is leſs than 10, ſet the product at the bottom, and a cypher at the top.

See the operation.	In order to prove this, obſerve the operation by the common way.
78492	78492
82	82
110104	156984
4688	627936
563716	6436344
6422	
6436344	

Having

Having thus finiſhed the multiplication of integers, the reader is to obſerve that there is this analogy in it, viz. as an unit is to the multiplier, ſo is the multiplicand to the product; for ſuppoſing one load of rough timber coſts 40 ſhillings, how much will 10 loads coſt?

RULE.

If 10 loads be multiplied by 40 ſhillings, the product 400 ſhillings, as in the margin, being conſidered as an unit, bears the ſame proportion to 40 ſhillings, the multiplier, as 10 loads, the multiplicand, doth to 400 ſhillings, the product.

$$\begin{array}{r} 10 \\ 40 \\ \hline 400 \end{array}$$

LECTURE LXIX.

OF THE MULTIPLICATION OF DECIMALS.

I Will not in this place treat upon the peculiar excellencies or antiquity of this ſort of arithmetick, but immediately proceed to a few examples, and then finiſh my treatiſe on multiplication with duodecimals, or what is vulgarly called croſs-multiplication with aliquot parts. Multiplication of decimals, both in placing the multiplicand and multiplier, is the ſame as multiplication of integers, only when the work is done, you are to obſerve, with a daſh of your pen, to cut off as many places

places of decimals in your product, as there are places of decimals both in your multiplicand and multiplier; and in case of want in your product, prefix cyphers to the left-hand.

It may be well to observe, that it will be convenient to make that number the multiplicand which contains the most places, though sometimes it may perhaps be less in quantity; secondly, that if the multiplicand and multiplier be both decimals, that is, be both parts of integers, the product will be decimals; thirdly, if the multiplicand and multiplier be mixed, that is, integers and decimal parts of integers, the product will be mixed; and, lastly, if the multiplicand and multiplier be mixed, and the other be a decimal, the product will be sometimes mixed, and sometimes a decimal.

Example 1. Of Decimals alone.	*Example* 2. Of Integers and Decimals.	*Example* 3. Multiplicand mixed. Multiplier a Decimal.
.5764	4.3625	27.5462
.732	2.13	.234
11528	130875	1101848
17292	43625	826386
40348	87250	550924
.4219248	9.292125	6.4468108

In example the 1st, of decimals alone, the product is .4219248 parts of an integer di-

vided into 10,000,000, becaufe the denominator of every decimal confifts of as many places of cyphers annexed to 1, as there are places in the decimals.

In example the 2d, there being 6 decimal places in the multiplicand, I have therefore cut off 6 places of figures from the product, and the product is 9 integers, and 292125 parts of an integer divided into 10,000,000 parts.

In example the 3d, I have cut off 7 places of decimals, 4 in the multiplicand, and 3 in the multiplier, and the product is 6 integers 4468108 parts of an integer divided into 10,000,000 parts.

LECTURE LXX.

OF DUODECIMALS, OR WHAT IS VULGARLY CALLED CROSS-MULTIPLICATION.

AS in decimal-multiplication the integer is divided into 10 parts, fo in duodecimals it is divided into 12 parts, as a foot into 12 inches, or a fhilling into 12 pence; in the following example fuppofe the integers to be feet and the decimals inches; this kind of multiplication may be performed as well by taking the aliquot, or even parts of 12, out of the multiplicand (as will be immediately fhewn) as by multiplying the multiplier into the multiplicand; but before I proceed to practice, obferve, that the aliquot (which are the

the even) parts of a foot, are as follow, viz. in 12 there are 6, which is the half of a foot, and must be so taken in the example; three times 4, four times 3, four times 2, six times 2, eight times $1\frac{1}{2}$, and twelve times 1.

In this kind of multiplication there is a great variety; and as I think it the most familiar, concise, and easy rule extant, for measuring, I shall give various examples for practice, and leave the reader to take which he most approves of; but before we begin, observe the following table.

When the multiplier is multiplied into the multiplicand, note,

Feet multiplied by feet, give feet.
Feet multiplied by inches, give inches.
Feet multiplied by seconds, give seconds.
Inches multiplied by inches, give seconds.
Inches multiplied by seconds, give thirds.
Seconds multiplied by seconds give fourths.

Example 1st.

Here I multiply the 6 feet and 3 inches by 4 feet 4 inches (which gives feet and inches for the product) saying, 4 times 3 is 12, set

o under the inches, and carry one to the feet; then 4 times 6 is 24, and one I carry makes 25, which I set down as in the margin; next I multiply 6 feet 3 inches by 4 inches, saying 4 times 3 is 12, which I set down under the place of seconds or parts, as observed in the table, and carry one to the inches, saying 4 times 6 is 24, and one I carry is 25, which are 2 feet 1 inch, which set down as in the example.

Ft.	In.	Pts.
6	3	o
4	4	o
25	o	o
2	1	o
27	1	o

Example 2d.

Ft.	In.	Pts.
9	7	o
6	3	o
57	6	o
2	4	9
59	10	9

Example 3d.

Ft.	In.	Pts.
4	6	o
6	4	o
27	o	o
1	6	o
28	6	o

Example 4th.

Ft.	In.	Pts.		
8	3	6	o	o
6	2	4	o	o
49	9	o	o	o
1	4	7	o	o
o	2	11	2	o
51	4	6	2	o

The following examples are another method of multiplying feet, inches, and parts, by multiplying the multiplier into the mulplicand.

Ft.

Ft.	In.	Pts.		Ft.	In.	Pts.		Ft.	In.	Pts.	
16	4	6		8	6	4		9	4	3	
		0	4 in.			0	6in.			0	7in.
5	5	6	4	51	0	2	0	5	5	5	9

These examples may be used when you want to multiply feet, inches, and parts, by inches; or any aliquot part of a foot, as in the above examples, which are 16 feet, 4 inches, and 6 parts, multiplied by 4 inches, by placing the multiplier one place farther to the right-hand, and then multiplying as in whole numbers: the second and third examples are the same.

To multiply Feet and Inches by taking the Aliquot Parts.

Now, supposing your dimension of several rooms for mouldings, or any thing that is measured by feet and inches, as in the margin; 263 feet 6 inches by 26 feet 6 inches; it would be too much for the head to say 26 times 6, as in the first example; therefore I multiply the feet into the feet first, saying 6 times 3 is 18, set down 8 and carry 1 as in whole numbers; and 6 times 6 is 36 and one I carry is 37, set down 7, and carry 3; then 6 times 2 is 12 and 3 I carry is 15, which set down; then begin with the 2, saying,

Ft.	In.
263	6
26	6
1578	0
526	0
131	9
13	0
6983	9

 2 times

times 3 is 6, which set down under the multiplier as in whole numbers; 2 times 6 is 12, set down 2 and carry one; then 2 times 2 is 4 and 1 I carry is 5, which is the whole.

Now as they are multiplied into themselves, instead of multiplying the feet and inches; take the aliquot part of a foot for the inches, which in this example are the half, being 6 inches, saying, the half of 2 is 1, which set down directly under the figure you so divide, and the remains, when there are any, carry to the next inferior part, as from feet to inches, inches to parts, &c. and every integer so remaining must be reckoned as 12 from feet to inches, and the like from inches to parts, &c. But to proceed, I have said the half of 2 is 1, then the half of 6 is 3, and the half 3 is 1, and 1 remains, which I carry to the inches, and call it 12, which added to the 6 inches in the multiplicand makes 18; then I say, the half of 18 is 9, which I set down under the inches, and proceed to take half of the multiplier 26 feet by 6 inches, in the multiplicand, which has not as yet been considered, saying as before, the half of 2 is 1, and the half of 6 is 3; the reader will observe, that the 6 inches in the multiplier were before taken, therefore place the several sums in proper order as in the margin, and add them together, and they will make the product 6983 feet 9 inches. It matters not whether feet be first multiplied, or aliquot parts taken, so that their respective products be all duely added together.

Example.		*Example.*		*Example.*		
Ft.	In.	Ft.	In.	Ft.	In.	Pts.
345	3	946	6	433	6	0
16	4	44	2	23	7	0
2070	0	3784	0	1299	0	0
3450	0	37840	0	8660	0	0
0115	1	00141	1	0144	6	0
0004	1	00022	0	0108	4	6
				0011	6	0
3639	2	41787	1			
				10223	4	6

The above examples will, I hope, be plain enough by inſpection, and need no more than this obſervation, that if the aliquot part be 11 feet 9 inches, or 7 inches, I take them at twice, as in the laſt example of 7, which I took at 3 and 4, being both aliquot parts of a foot, as before mentioned.

To multiply feet inches, and parts, by feet, inches, and parts, when the feet in the multiplicand and multiplier do not exceed twenty.

RULE.

First, place the feet of the multiplier under the parts of the multiplicand, and the inches and parts to the right-hand, and proceed to multiply as in whole numbers; only with this difference, carrying 12 for the remains. —See the examples.

Ft.	In.	Pts.		
8	6	4		
		6	3	2
	1	5	0	8
2	0	7	0	
51	2	0	0	
53	4	2	0	8

Ft.	In.	Pts.		
12	6	4		
		3	6	4
	4	2	1	4
6	3	2	0	
37	7	0		
44	4	4	1	4

Having thus given various examples of feet, inches, and parts; I shall only observe, that these being well understood will make the mensuration of either superfices or solids easy and delightful to every capacity. As some works are measured by the yard and feet, I shall just give a little instruction in this sort of measurement, and proceed to division.

Multiplication of Yards and Feet.

Observe, that yards multiplied by yards produce yards; when yards are multiplied into feet, every 3 feet make a yard, and the

4 remains

remains more than 3 are long feet; what I mean by long feet, is, 3 feet in length, and 1 broad. Feet multiplied by feet produce parts of a foot; which are ſquare feet, 3 of which make a long foot.—See the example in the margin.

Firſt, the yards being multiplied as integers, proceed to take the feet which I do thus, as one foot is one third of a yard as aforeſaid, I take the third of 463 yards 2 feet, which is 154 yards 1 foot, as at B; ſecondly, as 2 feet are two thirds of a yard, I take the third twice of 223 yards, which is 74 each, and place them as in the margin; and when added all together you have the true product, which is 93551 yards, 1 foot.

	463	2
	223	1
	1389	
	926	
	926	
B	154	1
C	74	
D	74	
	93551	1

LEC-

LECTURE LXXI.

OF DIVISION.

DIVISION is the reverſe of multiplication, for that turns ſmall denominations into greater, but diviſión turns greater into ſmaller, and therefore is no more than a compendium of ſubtraction; for as many times as the diviſer can be ſubtracted out of the dividend, ſo many units are in the quotient.

In whole numbers, of which only I ſhall yet ſpeak, Diviſion is the asking how many times one ſum is contained in another; and the number which anſwereth to that queſtion is called the quotient. Secondly, the number containing is called the dividend. Thirdly, the number contained, or by which the dividend is to be divided, is called the diviſor; and as often as the dividend contains the diviſor, ſo often doth the quotient contain unity; ſo that as multiplication is a compendium of many additions, diviſion is a compendium of many ſubtractions.

There are many ways by which this difficult rule of diviſion may be wrought, but ſome much eaſier than others to be performed; therefore, as eaſe and perſpicuity are the fundamental principles on which I build all my deſigns, I ſhall endeavour, in this as well as every other lecture, rather to inſtruct the ignorant, than point out new modes and ſtudied maxims, to acquire the ſelf-praiſe of the already accompliſhed.

Divi-

Diviſion in general is performed by this analogy; as the diviſor is to 1, ſo is the dividend to the quotient; which I ſhall illuſtrate by the following examples.

Example the Firſt.

A		B		C
100	|	436	|	4
		400		
		36		

If it be required to divide a floor which contains 436 feet into ſquares, as one ſquare contains 100 ſquare feet, place them as in the margin; 436, the dividend, as at B; then making a diviſion, place it at 100, as A; then make another, and placing it as at C, ſeek how often 100 is contained in 436 feet, which is 4 times; ſet down 4 as at C, for the quotient; multiply the 100 that is the diviſor by the quotient 4, ſaying 4 times 0 is nought, which place under the 6, and ſay, 4 times 0 is nought again, and place an 0 under the 3, then ſay 4 times 1 is 4, which place under the 4 as in the example; then make a line at the bottom of theſe numbers, and ſubtract from the dividend, ſaying, 0 from 6 and there remains 6, 0 from 3 and the remains are 3, and 4 from 4 you cannot, which leave 36 remains, that is to ſay feet, as in the margin; thus the work is 4 ſquare and 36 feet. In like manner is all diviſion of whole numbers wrought; at leaſt my method is ſo.

Example.

Example the Second.

Let 675 feet of dado, wainſcot, or any other ſuperficial work, that is meaſured by the yard, be brought into yards; as 9 ſquare feet therefore is a yard we divide by 9; place them as in the margin, and proceed as before; ſeek how often 9 can be had in 67, and you will find it to be 7 times, which is 63; note down this under 67, then making a line under them ſubtract as before, ſaying, 3 from 7 and there remain 4, which place in the margin, after this bring down the 5, and place that next the 4 to the right hand, and it makes 45 for a new dividend; then ſeek how often 9 can be had in 45; 5 times 9 is 45, which place under 45, the new dividend, and ſubtract as before, and your work is done, the whole being juſt 75 yards.

```
9 | 675 | 75
    63
    ——
     45
     45
     ——
     00
     ——
```

Note, If the dividend conſiſt of eight or ten figures, you muſt ſtill proceed till you have brought down all the figures in the dividend, as in the two foregoing examples. But ſee the following.

Let it be required to divide 876543 by 647.

EXAMPLES.

EXAMPLES.

```
49 | 564987 | 11530      647 | 876543 | 1354
     49                        647
     ——                        ———
      74                        2295
      49                        1941
      ——                        ————
      259                       3544
      245                       3235
      ———                       ————
       148                       3093
       147                       2588
       ———                       ————
        17                        505
```

LECTURE LXXII.

OF CONTRACTIONS IN DIVISION.

WHEN the divisor is 10, 100, 1000, or 10000, cut from the dividend the same number of figures to the right-hand as there are cyphers in the divisor; and the figures remaining to the left will be the quotient required; thus 6784 divided by 10, I cut off one figure to the right-hand as in the margin, and the quotient is 678, and four tenths the remains.

1,0 | 678 | 4

And

And if 984367 ſquare feet were to be brought into ſquares, or divided by 100, I only cut off two figures to the right of the dividend, as in the margin, and the work is done, which is nine thouſand eight hundred and forty-three ſquares and ſixty-ſeven feet. But ſee theſe examples by the common way.

100 | 9843 | 67

Example 1.		*Example* 2.
10 | 6784 | 678		100 | 984367 | 9843
60		900
78		843
70		800
84		436
80		400
4		367
		300
		67

And ſo of 1000, and alſo of 10,000.

The way to prove diviſion is to add all the products reſulting in the whole work together, in the ſame order as they ſtand in the work, and the ſum of them (adding the laſt remainder, if there be any) will be equal to the dividend.

vidend. Or this way; multiply the quotient by the divifor, and to the product add the remains if any, and if your work be true, it will be the fame as the dividend.

LECTURE LXXIII.

DIVISION OF DECIMALS.

AS divifion of whole numbers is the hardeft of the four fpecies of arithmetick, fo the divifion of decimals is the moft difficult of the four kinds of decimal arithmetick; but in this, as in the reft of my undertakings, I fhall endeavour to make it plain, eafy, and familiar to the weakeft capacity.

The general varieties which happen in the divifion of decimals are principally the following; firft, to divide whole numbers and fractions; fecondly, to divide whole numbers by mixed, or mixed numbers by whole; thirdly, to divide a greater fraction by a lefs; and laftly, to divide a leffer fraction by a greater. Divifion of decimals is performed in every refpect as whole numbers; only there is fome difficulty in difcovering the true value of the quotient; the following is a general rule.

The places of decimal parts in the divifor and quotient, being accounted together, muft always be equal in number to thofe in the dividend; and therefore as many figures as are cut off in the dividend, fo many muft be

cut

cut off in the divisor and quotient. Or thus; cut off as many figures in the quotient as will make those cut off in the divisor equal to those in the quotient; with this observation, that if there be not so many in the quotient, to add cyphers to the left-hand, and also, that if your dividend be an integer, or have less cut off than is in the divisor, to add cyphers to the dividend, till they be equal; this general rule admits of four cases.

CASE I.

Where the places of decimal parts in the divisor and dividend are both equal in number, as in the example, where both divisor and dividend are mixed numbers, then the quotient will be all whole numbers.

Example.

```
45.326 | 5642.435 | 124
         45.3026
         -------
          110983
           90652
         -------
          203315
          181304
         -------
           22011
         -------
```

CASE

CASE II.

Divide 6458.271 by 573, as in the margin; here the dividend is a mixed number, and the divisors are integers, and as here are 3 decimals in the dividend, and none in the divisor, therefore cut off 270 the last 3 figures in the quotient, and the quotient will be 11.27.

573 | 6458.271 | 11.27
573
.728
573
1552
1146
4067
4011
56

CASE. III.

Divide .84 by .0324. as in the margin; here the dividend is whole numbers, and the divisor a decimal; and seeing that 84 the dividend consist but of two places, I therefore add two cyphers to it, making it 8400, thereby both dividend and divisor may be made fractions; and by their being both of equal number of places, by case the first, the quotient is integers; when

.0324 | .8400 | 26
648
1920
1894
126

Y

when there are not ſo many places of decimal parts in the dividend as there are in the diviſor, then annex cyphers to the dividend to make them equal, and the quotient will be all whole numbers, as in caſe the firſt.

CASE IV.

645	4653000	612
	3870	
	7830	
	7710	
	120	

Divide 4653 by 645, as in the margin; now here the dividend being integers, and the diviſor a decimal, to bring out integers in the quotient I add 3 cyphers to 4653, the dividend, and the quotient is 412, and 120 remains; but if, after the diviſion is finiſhed, there are not ſo many figures in the quotient as there ought to be places of decimal parts by the general rule, then ſupply the defect by prefixing cyphers before the figures produced in the quotient; as for example; divide .421563 by 24. now here the dividend is a decimal, and the diviſors are integers, whoſe quotient is .17545; but as there are 6 places in the dividend, and but 5 in the quotient, therefore according to the general rule I prefix a cypher before the quotient 17545, making it .017545, which is the true quotient required,

```
24 | .421543 | .017545
      24
      ---
      181
      168
      ---
       135
       120
       ---
        156
        144
        ---
         123
         120
         ---
           3
```

From the preceding examples it is to be obſerved, firſt, that when the dividend is ſuperior to the diviſor, the quotient is either integers, or decimals and integers; and laſtly, that when the diviſor is ſuperior to the dividend, the quotient is a decimal; and this, in both caſes holds good in other examples.

LECTURE LXXIV.

OF REDUCTION.

REDUCTION is nothing more than a two fold composition of multiplication and division, for the use of changing a quantity out of one denomination into another, as a less into greater by multiplication; or a greater into less by division: as for example; if it be required to know how many superficial inches are contained in 7264 feet, multiply the feet by the number of inches in a superficial foot, and the product will be the contents required.

EXAMPLE.

$$\begin{array}{r} 7264 \\ 144 \\ \hline 29056 \\ 29056 \\ 7264 \\ \hline 1046016 \end{array}$$

In

In 1046016 inches how many ſquare feet? To bring this to its former ſtate, you muſt divide by 144.

```
144 | 1046016 | 7264
      1008
      ----
        380
        288
        ---
         921
         864
         ---
          576
          576
          ---
          000
          ---
```

As there is no other difficulty in this rule but to obſerve the denomination to which you are to reduce the given ſum or quantity, I ſhall not trouble the reader with any more examples of this ſort, but conclude with the following obſervation, that when we would reduce ſquares, rods, yards, feet, or any other denomination, we muſt find out the two quantities, and reduce one by diviſion, the other by multiplication.

EXAMPLE.

To reduce ſquares into feet, multiply the number of ſquares by 100, the number of ſquare feet in a ſquare, and the product will be feet; to reduce feet into ſquares divide by 100, and the quotient will be ſquares: to reduce yards into feet, multiply the yards by 9, the ſquare feet in a yard, will be the number of feet; to reduce feet into yards, divide by 9; to reduce loads of timber to ſolid feet, multiply the loads by 50, the ſolid feet in a load of timber, and the product will be the contents; to reduce ſolid feet into loads, divide by 50, the quotient is the load; and ſo of any thing elſe, whether money or meaſurement; but this rule is ſo obvious, that it needs no more inſtructions. I ſhall therefore proceed to the golden rule, or rule of three in whole numbers.

LECTURE LXXV.

THE GOLDEN RULE; OR, RULE OF THREE DIRECT.

THIS is one of the moſt uſeful and moſt ſimple rules in arithmetick, and for its uncommon utility, deſerves a golden name; its uſe is when there are three numbers given to find a fourth, which ſhall have the ſame proportion with them as they have one to another

ther; and is therefore properly called the rule of proportion. This rule is direct, indirect, and compound

First, the single rule of three direct finds a fourth number in such proportion to the third, as the second is to the first; or, as the second is to the first, so is the third to the fourth. But four numbers are in proportion, and called proportional, when as the first is to the third, so is the second to the fourth; as, if there were given 2, 3, and 4, to find a fourth, which may be to 3, as 4 is to 2, that is, double, and that fourth number is 6; this is called the proportion direct; and the rule whereby it is done, the direct rule.

There is also another proportion which is called reciprocal; which is, when as the first is to the third, so is the fourth to the second; as 3, 4, 6, and 2, and is called the rule of three reverse; by direct proportion, the product of the two middle numbers multiplied together, is always equal to the product of the first and last multiplied together, which serves not only as a proof, but as a ground of the rule, which rule here follows.

RULE.

Multiply the second term or number by the third, and divide the product by the first, the quotient will be the fourth number required.

EXAMPLE.

Let the three numbers given be 2, 6, 3; multiply 6 by 3, the product is 18; then divide 18 by 2, the quotient is 9, which is the fourth number in proportion with 2, 6, and 3; for as 2 is to 3, so 3 times 2, which is 6, are to 3 times 3, which make 9; and thus the product 18 being divided by 2, and the quotient 9, cause that the product of 2 into 9 shall be also 18; and consequently, if 2 be the first of the four proportional numbers, and 6 and 3 the two middlemost, then 9 is the last.

RULE.

To know when to use the direct or the reverse rule, consider if more require more, or less require still less, then use the direct rule: but if more require less, or less more, then use the reverse rule. But this will be easily understood by the following examples.

EXAMPLE I.

If the diameter of one circle be 7, and its circumference 22, what is the circumference of another circle whose diameter is 14?

First,

First, place your numbers as in the margin; secondly, multiply 14, the third number, by 22, the second number; and divide their product 308 by 7, the first number; the quotient 44 is then the fourth number, and the true anſwer required.

```
7 : 22 :: 14 : 44
          22
          ——
          28
          28
          ——
   7 | 308 | 44
       28
       ——
        28
        28
        ——
        00
```

When the fourth number is thus found, place it next after the third number, with two dots of ſeparation between them. The ſame kind of ſeparation is to be obſerved between the firſt and ſecond; between the third place 4 dots. Theſe points of ſeparation will then bear this analogy, as $7 \overset{\text{is to}}{:} 22 \overset{\text{ſo is}}{: :} 14 \overset{\text{to}}{:} 44$. The points are to expreſs the words as they are placed above them.

EXAMPLE II.

If the circumference of a circle be 22, whoſe diameter is 7, what is the diameter of another circle whoſe circumference is 44?

Here the nature of the queſtion requires the two firſt numbers to be placed the reverſe of the foregoing example; for as there the fourth number

number required was the circumference of a circle, ſo here on the contrary, the diameter of a circle is required; but the manner of working, by multiplying the third number by the ſecond, and dividing by the firſt, is the ſame here as before, as ſeen in this example, where the quotient 14 is the diameter required.

$$
\begin{array}{rl}
22 : 7 : & 44 : 14 \\
& \underline{\quad 7} \\
22 \mid & 308 \mid 14 \\
& \underline{22} \\
& 88 \\
& \underline{88} \\
& \quad 0
\end{array}
$$

Now as in both theſe and all other examples in the rule of three direct, the fourth number is always equal to one more than the ſecond; ſo in the rule of three direct, the fourth number is always leſs than the ſecond. And as the fourth number in the direct rule is found by multiplying the ſecond and third numbers together, and dividing their product; ſo on the contrary, in the indirect rule you multiply your firſt and ſecond numbers into one another, and divide their product by the third, as follows.

E X-

EXAMPLE III.

If 10 men can perform a certain quantity of work in 30 days, how long time will 20 men be in performing the same?

RULE.

Multiply 30, the second number, by 10, the first, and their product, which is 300, divide by 20, and the quotient, which is 15, is the answer required.

Men. Days. Men. Days.
10 : 30 : : 20 : 15
10
———
20 | 300 | 15
20
———
100
100
———
0

Of the Golden Rule Compound.

In the golden rule compound there are always five numbers given to find a sixth in proportion to them; which numbers must be so placed as that the three first may contain a sup-

ſuppoſition, and the two laſt a demand; and that you may place the numbers truely, always obſerve that the firſt number be of the ſame denomination with the fourth, the ſecond of the ſame denomination with the fifth, and the third with the ſixth required.

FXAMPLE.

If 8 men in 36 days lay 48 ſquares of flooring, how many ſquares can 6 men perform in 28 days?

RULE.

Firſt, ſtate the queſtion, as below; ſecondly, multiply the two firſt numbers, viz. 36 into 8, whoſe product is 288, as alſo the two laſt is 168.

Men.		Days.	Men.		Days.
8	:	36	6	:	28
		8			6
		288			168

Now the anſwer to this is found by the rule of three direct, by making 288 (the product of the firſt two) the firſt number; the third given number, 48 ſquares, your ſecond; 168 (the product of your laſt) your third number.

```
288  :  48  :  168
               48
             ------
         |   1344 |
             672
             ------
  288    |   8064 | 28
             576
             ------
             2304
             2304
             ------
               00
```

The anſwer is 28, that is 28 days, which is equal to 8 men in 36 days.

To prove the Golden Rule.

As the four numbers are proportionals, that is, the fourth is to the ſecond as the third is to the firſt, therefore the ſquare of the two means (which are the ſecond and third) is always equal to the ſquare of the two extremes, (that is the firſt and the laſt;) that is to ſay, if the product of the firſt and the laſt numbers, multiplied together into each other, be equal to the product of the two middles, the work is right, otherwiſe not.

So

So 8064 the product of

	288		168
	28		48
	2304		1344
	576		672
A	8064	B	8064

168 multiplied into 28, which are the two extremes of the above example, as at A, is equal to 8164, the product of 28 multiplied at 288, the two extremes of the same example, as at B; hence it is plain, that when the given numbers in the foregoing three varieties of the rule of three are truly stated, (and which, inded, is the only difficulty in the whole) the manner of performing the operation is very easy.

LECTURE LXXVI.

THE EXTRACTION OF THE SQUARE ROOT.

EXTRACTING the square root is no more than finding the side of a geometrical square, whose area is the side multiplied into itself. For example; 25 is a square number, which is produced by 5 being multiplied into 5; so in like manner 16 is a square number, produced by 4 multiplied by 4. The side

ſide of any geometrical ſquare is called its root. I have added a table of ſquare numbers, whoſe roots are the nine digits, and which, being nothing more than part of the multiplication table, I doubt not by the time the reader has got thus far, but he will have it by heart.

EXAMPLE

Let 625 be a root given to find its ſquare root.

1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81

RULE.

Multiply 625 into itſelf, as at *b c*, whoſe product is 390625, the ſquare number required, and whoſe root is thus extracted, viz. Firſt, place a point above the firſt figure to the right-hand as at *n*, and at every other figure to the left-hand as at *d* and *e*, and obſerve as many points as this ſquare number contains, ſo many places of figures the root will conſiſt of. Secondly, make a crotchet at the right-hand of the ſquare number as in diviſion; and note, that every two figures ſo pointed

pointed are called a punctuation. Thirdly, find in the table the nearest square number that is contained to the left-hand, viz. in 39, which is 36, whose root is 6, place 36 under 39, and its root 6 in the quotient, then substracting 36 from 39, the remains are 3, which place under 36, as in the example; this is your first work, and is not to be repeated. Fourthly, bring down the next punctuation 06 and join it to the remains 3, making 306 which is your first resolvend, and on its left-side make a crochet as in division, to separate the divisor from the dividend. Fifthly, double the root 6, which makes 12, place this at the left of the resolvend, as at *p*; then rejecting the last figure in the resolvend, which must always be done as at *g*, see how often the divisor 12 is contained in the remaining two figures in the resolvend, which is twice, therefore place 2 in the quotient at *f*, and also

```
          c 625
          b 625
          -----
           3125
          1250
         3750
         -----
         e d n     f
         . . .     .
        390625. | 62 5
        36
 p  b   -----
12..2 | 30.6 g
        24 4
        -----
124.5 | 6 22.5
        6 22 5 x
        --------
        0 00 0
```


at

at the right-hand of the divisor at *b*, and multiply 122, the divisor increased by 2, that is by two in the quotient, the product will be 244, which place under 306 the resolvend, this being subtracted from it, the remains are 62; which being done, bring down the next punctuation, and join it to the remainder 62, making it 6225 for a second resolvend, and then proceed as before, viz. double the quotient 62, which makes 124, place this on the left of the second resolvend; then see how often 124 is contained in the last resolvend (the last figure as before rejected) which is 5 times, place 5 in the quotient, and also to the right of the last divisor; then multiplying the divisor by 5 as before, place the remains under the resolvend as at *x*; then subtracting from the resolvend, you will find no remains, which shews that 390625 is a square number, whose root is the 625 required.

Note, if the square number consist of more punctuations, you must still bring them down, and proceed in every respect as before. Secondly, if at any time, when you have multiplied the number standing in the place of the divisor by the figure last found in the quotient or root, the product be greater than the resolvend; in such a case, you must put a figure less by one than the former in the quotient, and multiply by it as before: Thirdly, if at any time the divisor cannot be had in the resolvend, then place a cypher in the

 quotient,

quotient, and alſo on the right-hand of the diviſor, and to the reſolvend bring down the next punctuation for a new reſolvend, with which proceed as before. Whenever it happens after extraction is made, that there is a remainder, the number given is called a ſurd or irrational number. and its root cannot be exactly obtained, although by adding a cypher you may come as near the truth as poſſible.

EXAMPLE.

If it be required to extract the root of 160, the firſt punctuation here being 1, the ſquare of one is 1, which place under 1, then ſubtracting 1 from 1 there remains 0, accordingly ſet 1 in the quotient, and to 0 bring down the next punctuation 60, making the remains 060. Secondly, ſay, double the quotient 1 makes 2, which place for your diviſor as in the laſt example; now as 2 is contained three times in 6, after rejecting the 0 as before taught, being the laſt fiure in the reſolvend to the right-hand; I ſay, to place 3

```
         160 | 12.649
         1
        ------
    22 | 060
          44
        ------
   246 | 1600
         1476
        ------
 252.4 | 12400
         10096
        ------
2528.9 | 230400
         227601
        ------
           2799
```

in

in the quotient and divisor would make the latter 23, which being multiplied by 3 would be 69, that is more than 60, the first resolvend, and therefore cannot be subtracted from it; in such a case then as I have before stated, place a figure less but one in the quotient, that is 2, and also the same on the right of the divisor 2; then multiplying the divisor 22 by 2 in the quotient, the product is 44, which being placed under the first resolvend 60, and subtracted from it, the remains are 16. Thirdly, to the remains annex two cyphers, and make it 1600 for a second resolvend; then, proceeding as before, the next figure in the quotient will be 6, and 124 remains, to which annex two cyphers more, making the remains 12400 for a third resolvend, and proceed in like manner by continually adding two cyphers every time to each remainder till you have increased the figures in the quotient to as many places as may be required; in this I have increased them to three places, which I apprehend to be near enough for any business.

If it be required to extract the ſquare-root of 4096.

EXAMPLES.

4096 | 64
36
124 | 49.6
49 6
00 0

678960 | 823
64
162 | 38.9
32 4
1643 | 656.0
492 0
163 3

676 | 26
4
46 | 27.6
27 6
00 0

57284 | 238
4
43 | 17.2
12 9
468 | 4 384
3 844
540

LEC-

LECTURE LXXVII.

THE EXTRACTION OF THE CUBE-ROOT.

A Cube number is that which is produced by multiplying any number into itſelf, and its product again by the ſame number, thus 64 is a cube number, produced by 4, multiplied in 64.

A cube is a ſolid figure, contained under ſix equal ſquares, and may fully be repreſented by a dye.

Of cube numbers there are three diſtinct kinds or ſpecies, viz. ſingle, compound, and irrational. Firſt, ſuch are called ſingle cube numbers as are made of any one ſingle number, or ſignificant figure multiplied twice into itſelf, as 1 multiplies nothing, and is both root and cube; but 2 times 2 is 4, and twice 4 is 8, ſo that 2 is the root, and 8 the cube; alſo 3 times 3 is 9, and 3 times 9 is 27, here 3 is the root, and 27 the cube; and ſo of all the 9 digit numbers, as in the following table.

EXAMPLE

1		1		1
2		4		8
3	multipled	9	and that mul-	27
4	into itself	16	tiplied again	64
5	produceth	25	into the side	125
6	the square	36	produceth the	216
7	numbers,	49	cube num-	313
8		64	bers,	512
9		81		729

Compound cube numbers are those whose roots consist of more figures than one, as if 12 be the root then 12 times 12 is 144 the square, and 12 times 144 is 1728, which is a foot cube of timber, &c.

Irrational cube numbers are those whose exact cube cannot be found either by whole numbers, fractions, or decimals.

EXAMPLE.

Let 262144 be a cubed number given to find its root. First, point the first figure to the right-hand, then every third figure toward the left-hand as at *b d*. Secondly, look at your table of cubed numbers, and find the nearest cube number to 262, which is 216, whose root is 6, place

```
          d  b
          .  .
        262144 | 64
        216
     r  ------
 108 |  46144 Resolvend.
     u  432
        288 w
         64
        ------
        46144
        ------
        00000
```

place 6 in the quotient, and 216 under 262, and ſubtracting 216 from 262, the remains are 46; bring down the next punctuation 144, and annex them to 36, making it 46144, which is your firſt reſolvend. Now to find a diviſor by which you are to divide this reſolvend, its two laſt figures excepted, which muſt always be done, proceed in the following manner, viz. Firſt, ſquare the quotient 6, which is 36, treble this makes 108, and is the diviſor required as at *r*; then ſeek how often you can have 108 in 461, rejecting the two figures to the right, as obſerved 4 times, which is equal to 432, place theſe under the reſolvend 461 as at *u*, and ſet 4 in the quotient. Secondly, treble 6 the firſt figure in the root equal to 18, which multiplied by 16, the ſquare of 4, the laſt figure in the quotient makes 288, place this under 432, in one place to the right-hand as at *w*; alſo cube 4, the laſt figure in the quotient, which is equal to 64, which place under 288, one place more to the right-hand, as at *r*; then the three ſubducends 432.288, and 64 being added together as they ſtand, their ſum make a ſubtrahend of 46144, which being ſubtracted from the firſt reſolvend, their remains are nothing, and this ſhews that 262144 is a cube number, whoſe part is 64.

EXAMPLES.

```
        110592 | 49
        64
        ------
   48 | 465.92
        432
         972
          721
        ------
        53641
        ------
         2951
```

```
        146363183 | 527
        125
        ------
   75 | 213.63
        150
         60
          8
        ------
        15608
        ------
 8112 | 5755.183
        5678 4
          76 44
            343
        -------
        5755182
        -------
        0000000
```

```
        103823 | 47
        64
        ------
   48 | 398.23
        336
         588
          363
        ------
        39823
        ------
        00000
```

```
        117649 | 49
        64
        ------
   48 | 536.49
        432
         972
          729
        ------
        53649
        ------
        00000
```

EX-

EXAMPLE.

```
        . .
     110592 | 48
     64
     ------
48 | 465.92
      38 4
       7 68
        492
      -----
      4 6572
      -----
      0 0020
```

LECTURE LXXVIII.

OF MENSURATION.

THE reader is to obſerve of the following treatiſe, that every quantity is meaſured by ſome other quantity of the ſame kind, as a line by a line, a ſuperfice by a ſuperfice, and a ſolid by a ſolid; and the number which ſhews how often the leſſer, called the meaſuring unit, is contained in the greater, or quantity meaſured, is called the content of the quantity ſo meaſured: thus, if the quantity to be meaſured be a ſuperfice, whoſe dimenſion is 8 inches by 6, and the meaſuring unit an inch each way; then as many times as the unit is contained in the above rectangle, which muſt be 8 times 6, viz. $\overset{m}{48}$, is the number of ſuperficial

ficial inches contained, from whence it is eafy to conceive, that any fquare or rectangular figure may be found by repeating the number of parts into which the length is divided by the fide of the meafuring unit, as often as there are parts in the breadth of the fame, whether inches, feet, yards, fquares, &c. for it is in familiar fpeaking but multiplying one fide by the other, and the product is the area required of all regular figures.

How to meafure the Area of a Triangle.

RULE.

Multiply the bafe by half the perpendicular, let fall or ftruck fquare from the bafe, or what is called the hypothenufe, to the point of the right angle, and the product is the contents required. Suppofing the bafe of a triangle to be 25, and half the perpendicular let fall 9, multiply them as in the margin, and the product is the content required.

$$\begin{array}{r} 25 \\ 9 \\ \hline 225 \end{array}$$

To

To find the Contents of a Trapezium-figure, whoſe Sides are parallel, though of unequal Length.

RULE.

Add the two ſides together, and take half for the length; multiply that by the width, the product will be the contents required. Suppoſing the 2 ſides added together to be 54, and the width of the plane 16, I place them as in the margin, and the product is the contents required.

27
16
162
27
432

To find the Content of any unequal-ſided Figure.

RULE.

Divide it into triangles, and meaſure it as before taught; then add the ſeveral ſums together, and theſe will be the contents required.

Having ſhewn how any right-lined ſuperficial figure may be computed, it may be proper to ſay ſomething with regard to the area, and circumference of a circle.

It is well known, that to determine the true area of a circle, and to find a right line exactly

ly equal to the periphery or circumference thereof, has been looked upon by mathematicians as abſolutely impoſſible; I hope the learner therefore will be content with ſuch methods as ſhall be near enough to approximate any thing required in the building branch, and have been thought ſo, not only by Archimedes, but every author ſince.

LECTURE LXXIX.

OF CIRCLES.

THE *diameter of a Circle being given to find its Circumference.*

RULE.

As 7 is to 22, ſo is the diameter to the circumference. Suppoſe the diameter to be 9 feet, firſt multiply the diameter 9 by 22, the product is 198, which divided by 7 gives 28 feet and 2-7ths of a foot for the circumference.

$$
\begin{array}{r|c|l}
 & 22 & \\
 & 9 & \\
\hline
7 & 198 & 28 \\
 & 14 & \\
\hline
 & 58 & \\
 & 56 & \\
\hline
 & 2 & \\
\hline
\end{array}
$$

The Circumference of a Circle being given, to find the Diameter.

RULE.

Multiply the circumference by 7, and divide by 22, the quotient will be the contents required.

The Diameter of a Circle being given, to find the Area, or superficial Contents.

RULE.

As 7 is to 22, so is the square of the semi-diameter to the superficial contents.

Supposing the semi-diameter to be 4 feet, that squared is 16, which multiplied by 22 give 352, and that product divided by 7, the quotient is 49 feet, the area of the circle required.

```
     16
     22
    ----
     32
    32
    ----
7 | 352 | 49
    28
    ---
     72
     63
     --
      9
```

How

How to meaſure any Part or Portion of a Level.

RULE.

Multiply half the arch-line by the ſemi-diameter, and the product will be the ſuperficial contents.

To find the ſuperficial Contents of a Cylinder.

RULE.

As 7 is to 22, ſo are the diameter and length of the ſide multiplied one by another, to the ſuperficial contents of the outſide of the cylinder. Suppoſing the diameter to be 5, and the length 12, theſe multiplied together make 60; and again multiplied by 22, the product is 1320, which divided by 7 give 188 feet, the ſuperficial contents.—Note, This may be done by girting the cylinder for the width multiplied by the length.

```
    12
     5
   ----
    60
    22
   ----
   120
   120
   ----
7 | 1320 | 188
    7
   ----
    62
    56
   ----
     60
     56
    ----
      4
```

To measure the Superfice of a Dome or Globe.

RULE.

Multiply the diameter by the circumference, and the product is the contents required.

How to measure a Pyramid.

RULE.

Add all the four ſides of the baſe together, and take half the ſum multiplied by the height, which will be the ſuperficial contents required.

LECTURE LXXX.

OF SOLIDS.

SOLID figures or bodies are ſuch as conſiſt of three dimenſions, viz. length, breadth, and thickneſs, as ſtone, timber, earth, or any other ſolid body whatever. The difference in the meaſurement of ſuperfices and ſolids is this; in the former you have only to meaſure the length with the breadth; in the latter you have to multiply that product by the thickneſs, as in the following example.

Sup-

Supposing a cubical figure to be 1 foot 6 inches by 1 foot 6, and 2 feet deep, first multiply 1 foot 6 inches by 1 foot 6 according to duodecimals, and the product by 2 feet, the depth, the contents $4\frac{1}{2}$ feet solid.

Ft.	In.	
1	6	
	1	6
	9	0
1	6	
2	3	0
	2	
4	6	

All regular solid bodies that are above a foot in the square may be measured by duodecimals, being much the simplest and readiest method.

Supposing a piece of square timber to be 2 feet 6 inches by 1 foot 3 inches, and 9 feet long.

EXAMPLE.

First multiply 2 feet 6 inches by 1 foot 3, and that product by the length, then the last product will be 29 feet 7 inches 6 parts, the content required.

Ft.	In.	
2	6	
	1	3
	7	6
2	6	
3	3	6
		9
29	7	6

To

To meaſure the ſolid Contents of any Scantling of Timber under a Foot.

Multiply one ſide by the other, that is, ſquaring one end, and multiplying that by 12 gives the ſolid inches in one foot long; afterwards multiply that product by the number of feet the piece contains in length, and the product will be the contents in inches; then divide by 1728, the cubical inches in a foot, and you will have the ſolid contents in feet.

EXAMPLE.

Suppoſe a piece of timber the ſcantling of which is 8 by 3, I ſay 8 times 3 is 24, and multiplying that by 12 gives 288 ſolid inches; next multiply the length 25 into 288, and divide by 1728, this gives 4 ſolid feet of timber, and 288 ſolid inches, which is ſomewhat leſs than a quarter of a foot

	3	
	8	
	——	
	24	
	12	
	——	
	288	
	25	
	——	
	1440	
	576	
	——	
1728	7200	4
	6912	
	——	
	288	

To find the solid Contents of a Pyramid.

RULE.

First find the superficial contents of the base, or biggest end, that the product being multiplied by one-third of the height, the product will be the superficial contents. The same also if the base be a triangle.

LECTURE LXXXI.

OF MEASURING ROUND TIMBER.

IT is customary in measuring round timber, if a tree be regularly shaped, to girt it in the middle with a string, for a mean between the two ends; the string then must be doubled four times for the girt. Thus if a tree be 32 inches in circumference the girt is 8 inches.

RULE

RULE to measure it.

Square the girt, and multiply that by 12, and the product by the length, and divide by 1728, you will then have the contents required, as in the margin, which is 11 solid feet and 192 solid inches, that is to say near $\frac{3}{4}$ of a foot.

8
8
—
64
12
—
768
25
—
3840
1536
—
1728 | 19200 | 11
1728
—
1920
1728
—
192

Note, If the timber girt be above a foot, you may measure by duodecimals, which is much the best and easiest method. See the following

EXAMPLE.

Suppoſe a piece of round timber or ſtone to be in girt 1 foot 3 inches, firſt ſquare that, and multiplying the product by the laſt product, you will find the contents required to a length of 8 feet; and ſo of any other dimenſion.

1	3	
	1	3
	3	9
1	3	
1	6	9
		8
12	6	0

LECTURE LXXXI.

OF GEOMETRY.

GEOMETRY is that ſcience by which we compare all quantities together that have extenſion, being the baſis of building, and on which almoſt every art depends.

Geometry is both ſpeculative and practical; the former elucidates the properties of lines, figures, and angles; the latter teaches how to apply or reduce them to practice in architecture, &c.

Extenſion is conſidered by length, breadth, and thickneſs.

A line is that which hath length without breadth. The bounds of a line, or extremes, are called points, and have no magnitude or extenſion to be divided to our ſight. When extenſion, called quantities, is conſidered as lengths,

lengths, they are only called lines. Thoſe with lengths and breadths are called ſurfaces. A right-line is that which lies evenly between its extremes, or every where tends the ſame way. An angle is the opening or inclination of two right lines meeting each other in a point.

An acute angle is that which is leſs than a right angle. An obtuſe angle is that which is greater than a right angle. Two right lines are ſaid to be equidiſtant, when perpendiculars are any way taken and are of equal length.

A right-lined plane figure is that whoſe bounds are right lines.

All plane figures bounded by three lines are called triangle.

A right-angled triangle is that which has one right angle, whereof the ſide oppoſite to the right angle is called the hypothenuſe.

An equilateral-triangle is that whoſe ſides are all equal.

A ſcalene-triangle is when all the three ſides are unequal. A rectangle is a ſquare whoſe ſides and angles are equal.

Parallelogram, whoſe angles, if right, are called rectangles.

A trapezium is an irregular four-ſided ſquare.

A circle is a figure bounded by one line, called its periphery or circumference.

Every right line paſſing through the centre of a circle, and terminating in the circumference, is called a diameter.

An arch of a circle is any portion of the periphery or circumference.

The chord or ſubtenſe of an arch is a right line joining the two extremes of that arch.

A ſegment of a circle is a figure contained under a ſemi-circle.

A ſemi-circle is a figure contained under any diameter, and the part of the circumference cut off from that diameter.

A ſector of a circle is a figure contained under two right lines drawn from the centre to the circumference.

The radius of a circle is the diſtance of the centre from the circumference.

Theſe figures and bounds mentioned are part of one of the great principles of geometry, being diſtinguiſhed into three parts, viz. poſtulates, axioms, and definitions. The former being demands or ſuppoſitions, intimate, that from any given line or point another right line may be drawn.

That from any centre or diſtance, or with any radius, the circumference of a circle may be deſcribed.

Alſo, that the equality of lines and angles to others given be granted as poſſible for one right line to be perpendicular, or parallel to another, at a given point or diſtance; and that every magnitude hath its half, quarter, third, fourth, &c.

The ſecond principle is axioms or ſelf-evident truths, as that every whole is greater than its half. Or,

That every whole is equal to all its parts.

Alſo, that if to equal things equal things be added, the whole muſt be equal.

That all right angles are equal to each other, and if from equal things equal things be taken, the remains will be equal.

The third and laſt principle is definitions, which are the explications of ſuch terms, figures, and words, as concern a propoſition in order to render it intelligible and plain to the underſtanding, that every objection in demonſtration may be comprehended without difficulty.

By a propoſition is underſtood ſomething propoſed to be done or deſigned.

Alſo, when a problem is named, ſomething is propoſed or intended to be done.

A theorem is when ſomething is offered for demonſtration.

A lemma is a premiſe demonſtrated with a view to render what follows, and what was firſt intended plainer.

A ſcholium is, when remarks or obſervations are made upon ſomething going before. A corollary is a truth gained from ſome preceding conſequent truth or demonſtration.

The proper deſign of a definition being to ſhew and explain the term or thing deſigned, ſo as to give a preciſe and competent idea thereof, it is certain the exact meaning of every term made uſe of in a definition ought to be perfectly underſtood, or at leaſt ſhould

be better known or more commonly received than the term to be defined. It was from this motive that I have made free to nominate ſome of the principles of geometry, in order to animate the ſtudent to the ſearch of it, which, if purſued with vigour, will give ſuch ſatisfaction from the juſtneſs of its reaſoning, as is only peculiar to the ſubject, and create a thirſt for the ſpirit of its profundity.

Having ſaid ſo much, and extended this volume beyond its intended ſize, I muſt beg the reader's pardon for any miſtakes committed either through deficiency of language, or errors of the preſs, and that he will turn his thought upon the extenſion and real meaning of the ſubject. I hope alſo he will at leaſt acknowledge my intent was good, and if thoſe who may be unacquainted with many of the matters ſpoken of, will but take upon themſelves to ſtudy as much for their own advantage as I have done for the general benefit of mankind, I am perſuaded they will not think their labours loſt.

A
DISSERTATION
ON THE LATE
BUILDING ACT,
With proper Rules and Directions for every
CLASS OF BUILDING.

A

DISSERTATION

ON THE LATE

BUILDING ACT.

LECTURE LXXXIII.

BUILDING is a Science truly ſublime, and of ſuch an important nature, that the moſt florid pen would but convey a faint idea of its excellence; eſpecially if we conſider the benefits that ariſe from its many advantages. I ſay, if we conſider theſe, we ſhall not find the ſubject too trivial for the univerſal ſtudy of our firſt ſeminaries, nor their mode of erection beneath the guidance of a Britiſh Senate, who have ſo lately undertaken the reformation of many groſs and unpardonable abuſes which cuſtom had introduced among us, and which were every day growing worſe for want of animadverſion. Not but the late Act

Act of Parliament is replete with errors, not through design, but in many cases for want of a just knowledge of the disadvantages that must arise to many peculiar businesses, by granting benefits to others which cannot be avoided, unless we give scope to invention, and institute some other mode of building.

One of the most inconsiderate clauses in the act is, the prohibition of frontispieces of wood, which could never enter the thoughts of any body but a mason, who could not bear to see any thing executed in wood that might yield so great a profit to his own trade in stone. If frontispieces of wood were in any wise detrimental, their being set aside would be an act of prudence; but as they are not, I think it a point of unparalleled cruelty to oblige a builder to give 25, 30, or 35*l.* for a frontispiece, when he might have one of wood, superior in elegance, for half the money.

If houses were to take fire on the exterior parts, frontispieces might be of disservice; but as this rarely or never happens, they cannot be dangerous: besides, in point of security, they can at any time and in any case be taken down in three minutes. There are many matters of much more consequence in a building not restrained, and which are replete and pregnant with danger. This strikes me with an immediate thought, that a mason must have propounded and devised the act—for no publick advantage—but the peculiar emolument

ment of his own branch! For it is well known that masons have a greater profit upon frontispieces than any thing in their trade, through a want of knowledge in surveyors of the exact labour that is required in matters of this sort.

An act to prevent many errors in building, was long a desirable matter, and of some moment. If it had made its appearance ten years ago, it would have been the means of saving many unthinking men from the disgrace of a prison; and preserved numbers of, now distressed, families from lasting ruin and poverty.

The terrors of a fine, in case of non-compliance to an established standard made by parliament, would have deterred numbers of builders in *Marybone*, and other out-skirts of the town, from attempting matters which they had neither the experience to execute nor means to carry on. Many, to my certain knowledge, turned builders who never served their time to any business, and without the possession of one requisite in the science, unless a thirst of money may be called so: these, hurried on by their passions, laid out ground without understanding, contrived rooms without meaning, built walls and chimnies without thought, which were of no other use but to enhance the price of timber, by cutting piles upon piles and fixing them in unnatural order, as if they had been just erected to make up the row without form or service; unconnected

nected and ill concerted; void of grace, ſtrength, and convenience—and to the laſting ſhame of the *London* builders, it may be juſtly affirmed, that there are hundreds of buildings about the town, which are of leſs value when finiſhed than the materials were before uſed.

But thoſe defects will be all prevented in future, by the preſent act, which has alluſion not only to the ſtrength of walls, but alſo the conſequence of foundations.

For a more clear conception, however, of this act, it may be requiſite to enquire into the merits of every claſs of building, with ſome ſtrictures thereon, ſeparately as they occur.

Of the First Class *of Building, as directed by Act of Parliament.*

IT is enacted that every publick place of worſhip, and every building for diſtilling and brewing of liquors for ſale; every building uſed for caſting of braſs or iron, for refining ſugar, making glaſs for chemical works for ſale; every building for making of ſoap, melting of tallow, for dying, for boiling turpentine; and alſo every warehouſe or building whatſoever, not being a dwelling houſe, now or hereafter to be built (except thoſe buildings of the fifth, ſixth, and ſeventh claſſes) which ſhall exceed three clear ſtories above ground, excluſive of garrets (which are not to

to be considered as a story) shall be thirty-one feet from the ground to the top of the parapet. And every dwelling-house now built, or hereafter to be built, with the offices thereunto belonging and adjoining or connected, otherwise than with a fence, wall, or covered passage, open on one or both sides when finished, and which shall exceed the sum of eight hundred and fifty pounds, and contain more than nine square of building, is deemed the first class of buildings.

To which first class it is enacted, that all foundations to the outward wall, or to any addition thereto, must be built and remain of the thickness of two bricks and a half at least, and may be regularly diminished on both sides to two bricks: the footing must be nine inches at least, and be wholly below the cellar floor, two inches at least; and every outward wall from the said foundation must be continued two bricks to the one pair of stairs floor, and from thence to the raising or gutter-plates, one brick and a half; the parapet to be one brick to the coping. Also, that all recesses to this class of building, for closets, bookcases, &c. that may be left or cut in external walls, have one brick thick in the back at least, and be arched over the same; also, that the foundations of party walls in this first class of building, likewise all additions, &c. must be of the thickness of three bricks and a half at the bottom, and regularly diminish

on

on each ſide four inches to the top of the ſaid foundation, which ſhall be in height one foot, and two inches below the cellar floor, and from thence ſhall be continued with two bricks and a half to the ground floor; afterward, in two bricks to the floor of the higheſt room in the houſe, and from thence with one brick and a half through the roof, and above the ſame one foot ſix inches.

Alſo, if at any time you are building a houſe of the firſt claſs, and the adjoining one ſhould be of the third or fourth claſs only, you muſt in that caſe build the party wall the ſame in every reſpect with the directions for the firſt claſs of buildings.

The above clauſes in the act of the firſt claſs have very few faults, and little room for complaint, except the inconvenience of being obliged to call on every occaſion the ſurveyors to juſtify their proceedings; for it cannot be imagined that any ſenſible man would propoſe to build walls of leſs magnitude than the above dimenſions, though it has frequently been done by men of deſperate undertakings. A prudent builder muſt be well apprized of the fatal conſequence attending ſuch gingerbread ſtructures.

The walls, in point of propriety, lack ſubſtance; and if the ſize of the building were augmented above this proportion, I will be bold to affirm, would be inadequate to the purpoſe: this will very plainly appear by examining

amining my ſtandard of walls, which are as light as any building ought to be.

Of the SECOND CLASS *of Buildings.*

THE ſecond claſs imports that every ſtable, or other building, not uſed as a dwelling-houſe, now built, or hereafter to be built, which ſhall exceed two clear ſtories, and not more than three out of the ground, and ſhall be twenty-two feet, and not exceed thirty-one feet from the ground to the top of the parapet; and alſo, every dwelling-houſe now built, or hereafter to be built, which with the offices, &c. (as mentioned in the firſt claſs) when finiſhed ſhall exceed the value of 300*l.* and not more than 850*l.* ditto, and ſhall contain five ſquares of building, ſhall be deemed the ſecond claſs of buildings.

To which ſecond claſs of buildings all the footings or foundations muſt be built of the thickneſs of two bricks at leaſt, and may be diminiſhed two inches of a ſide; the height of the ſaid foundation muſt be nine inches, and two inches below the floor of the cellar; and ſuch outward walls muſt be continued one brick and a half to the one pair of ſtairs floor, and from thence with one brick to the parapet.

The party walls to the ſecond claſs and all additions, &c. muſt be of the thickneſs of

three bricks and a half at leaſt, and may be diminiſhed on each ſide of the ſaid foundation to the ſet off on the baſement ſtory four inches; the height of the foundation muſt be nine inches, and below the ſurface of the cellar floor two inches; from the ſet off on the foundation to the ground floor two bricks and a half, from thence to the two pair of ſtairs floor two bricks, after that in one brick and a half to the top through the roof, and one foot ſix inches above the back of the rafters.

Of Buildings of the Third Class.

TO the third claſs it is enacted, that every ſtructure, whether warehouſe or ſtable, not being a dwelling houſe, now built or hereafter to be built, which ſhall exceed one clear ſtory, and ſhall not be more than two, and more than thirteen feet, and not exceed twenty-two feet from the ſurface of the ground to the top of the parapet; and alſo every dwelling-houſe either now or hereafter to be built, with the offices, &c. (as mentioned in the firſt claſs) which when finiſhed ſhall exceed the ſum of one hundred and fifty pounds, and not exceed three hundred, and ſhall run above three ſquares and a half, and not exceed five ſquares of building, ſhall be deemed the third claſs of buildings, and ſubject to ſuch rules and reſtrictions as is ſpecified in the ſaid act.

With

With respect to the external and party walls: And first, of the foundations to outward walls with all additions; they must be built of the thickness of two bricks, and may be diminished upwards of two inches of a side, the height not less than six inches, and wholly two inches below the surface of the cellar floor, and from thence to the ground floor be one brick and a half, afterwards must be one brick continued to the top of the parapet.

The foundations of the party walls must be three bricks in thickness, and may be diminished four inches on each side to the top of the said footing; the height of the foundation must be nine inches, and two inches below the surface of the cellar floor, from the foundation to the underside of the ground floor, two bricks from thence to the top of the roof, and one foot six inches above the back of the rafter in a brick and a half.

Instructions as to the FOURTH CLASS *of Buildings.*

NOTE, that every stable, warehouse, or building not being a dwelling-house, now or hereafter to be built, which shall not exceed one clear story, or may not be more than thirteen feet from the ground to the top of the parapet; and also every dwelling house now or hereafter to be built, which, with the offices, &c. shall not exceed the value of one

hundred and fifty pounds, or may not exceed three ſquares and a half of building, ſhall be conſidered under the fourth claſs.

All the foundations to which of external walls muſt be (and all additions thereto) two bricks, and may be diminiſhed on each ſide two inches; the height of the foundation to be ſix inches at leaſt, and two inches below the floor, from thence muſt be continued one brick and a half to the underſide of the ground floor: and afterward one brick to the top of the parapet.

The foundations of the party walls muſt be of the thickneſs of two bricks, and may be diminiſhed two inches on each ſide of the wall, the height of the foundation nine inches, and two inches below the floor of the cellar, from thence to the ground floor one brick and a half and to the top of the building, and one foot ſix inches above the back of the rafter the ſame.

All the above obſervations and inſtructions being abſtracts from the act, will ſerve as a guide to builders in not exceeding the limits; but for my own part, I would admoniſh every man of reaſonable thinkings, not to abide by the above dimenſions. In other reſpects than the party walls, all the reſt I would conſiderably augment in thickneſs, being, as I before obſerved, too ſlight in proportion to the different heights.

The

The builders are to obſerve that theſe ſtandards of outward walls are not calculated as juſt ones, but are pointed out as the very fartheſt limits which juſtice ought to allow; and likewiſe to prevent builders (through inexperience) from exerciſing their faculties in ſchemes which will in no wiſe anſwer their purpoſe nor the publick's.

Inſtructions for the FIFTH CLASS *of Buildings.*

ALL dwelling-houſes, ſtables, or warehouſes (except ſuch buildings as are particularly nominated in the firſt and ſeventh claſſes) which are at any diſtance from four to eight feet from any publick way or road, and are detached from any other buildings not in the ſame poſſeſſion, from ſixteen to thirty feet, by any other means than a fence or fence-wall, ſhall be deemed the fifth claſs, and may be built of any dimenſions, of ſtone or brick, without reſtriction as to the walls, which are left entirely to the builder's own judgement.

Inſtructions to be obſerved in the SIXTH CLASS *of Buildings.*

TO the ſixth claſs every ſtable, warehouſe, dwelling-houſe, or other building (except ſuch ſtructures, not being dwelling-places, as are particularly declared to be of the firſt claſs) which is at the diſtance of eight feet at leaſt from the road, and thirty feet

from any other building not in the ſame poſſeſſion, only by a fence-wall, ſhall belong and may be built of any materials or dimenſions whatſoever.

Directions to be obſerved as to the Seventh Class.

ALL windmills or watermills, and every building ſituated without the cities of London and Weſtminſter, and the liberties thereof, uſed for workſhops, or drying places for feltmongers, curriers, tanners, leather-dreſſers, oil-cloth painters, buckram-ſtiffeners, wool-ſtaplers, throwſters, callico printers, whitſters, whiting-makers, glue, ſize, and parchment-makers, ſo long as they ſhall be uſed for the trades above-mentioned, ſhall be deemed the ſeventh claſs of buildings, and may be built of any materials or dimenſions whatſoever.

Inſtructions for Offices to Buildings.

Obſerve that every office built or to be built, belonging to any building of the firſt, ſecond, third, or fourth claſs of buildings, if they are apart from the main building, or ſhall be connected only by a fence or fence-wall, or covered paſſage, open upon one or both ſides, ſuch office ſhall be conſidered according to the claſs and dimenſions it belongs to, and be built agreeably thereto.

Of Party Walls between House and House.

Where any adjoining houſe is rebuilt, the owner of the adjoining houſe is entitled to half the old materials and half the ſcite of the party wall when pulled down.

If a houſe conſiſt of five ſtories or more, the party walls muſt be ſubject to the directions of the firſt claſs of buildings, notwithſtanding the houſe may not be in manner of the firſt claſs.

Note alſo, that every party wall built to any dwelling-houſe containing four ſtories, muſt be built after the ſecond claſs, notwithſtanding ſuch building may not be of the ſecond rate.

If the owner of any building ſhould pull down the ſame, and the adjoining houſe ſhall be of the firſt, ſecond, third, or fourth, claſs of buildings, or be four ſtories high, and if in ſuch caſe the old party wall ſhould not be of the thickneſs of two bricks at the leaſt from the foundation to the underſide of the ground floor, and from thence to the top of the building of the thickneſs of one brick and a half, ſuch party wall, when either of the adjoining houſes or buildings to which the ſame belongs muſt be rebuilt, is in that caſe conſidered a ruinous wall and muſt be pulled down.

Alſo obſerve if any timber be lying in any caſe through a party wall, and upon rebuild-

ing the adjoining house, the owner of such party wall shall refuse to let the said timbers be cut off, so as to leave six inches brick-work against the same; in such a case every wall shall be considered as ruinous, and must be taken down and rebuilt.

Likewise all timber partitions (when either of the adjoining houses are rebuilt, or shall have either of their fronts abut against such timber partition) must be taken down, or two thirds of the front on either side taken down to the bressimer or one pair of stairs floor, and afterwards have a party wall built according to the rules or class that such a building is within.

Observe that no end or flank walls whatever can remain as party walls for any adjoining building, unless such wall shall contain the proportions of height and thickness above the foundations, and be of the same materials as is before mentioned of such a class as the building shall be in.

Also, in case any dormer window, or any other erection whatever, shall be raised or fixed on the flat of any roof, or building within four feet of any party wall, then such party wall must be built up against such erection and must extend two feet wide and to the full height of such erection.

No openings of whatever nature must be made in any party wall except for communication from one tier of warehouses to another, or stables, and even then there must be doors

of

of wrought iron one quarter of an inch in the pannels; and alſo jambs and cells of ſtone: neither muſt there be any timber whatſoever near ſuch an opening; neither muſt any receſſes be made in any party wall except flues for chimnies, and ſuch timbers as are appointed.

No row of warehouſes that ſhall be built muſt exceed thirty-five ſquares of building, but muſt have party-walls agreeable to the claſs of buildings they belong to; nor muſt any row of ſtables be built that ſhall exceed twenty-five ſquares but muſt have party walls alſo.

No timber whatſoever ſhall be laid into party walls, ſave bond timbers, ends of girders, beams, purlings, trimming or binding joiſts; all ſuch timbers too muſt have eight inches and a half of ſolid ſtone or brickwork at the ends and ſides, except the ends of ſuch timbers ſhould lie oppoſite to each other. In that caſe they muſt have four inches of brick-work betwixt the ends in the centre of the wall.

All breſſimers and ſtory poſts may be let into any party wall, but not more than two inches.

Obſerve, that you may cut into any party wall for the purpoſe of letting in ſtone ſteps or ſtone landings, or for placing in bearers for wooden ſtairs, ſo that they be eight inches and a half from any flue or chimney, or four inches from any timbers of the internal finiſh-

ings

ing of the adjoining houſe. You may alſo cut into any party wall to inſert croſs walls, or piers, provided they be not more than fifteen inches wide, or more than four inches deep, and you muſt not make any receſs nearer than ten feet from any other, and no party wall muſt be cut into which ſhall diſplace, injure, or endanger any of the timbers, chimnies, flues, or of the adjoining buildings. You may alſo cut off the footing of any party wall for the advantage of building another wall againſt the ſame, but you muſt be careful to under-pin the ſame directly underneath.

Publick Paſſages.

All publick paſſages under any building muſt be arched over with brick or ſtone, and if of a building of the firſt and ſecond claſs muſt be a brick and a half thick; and in the third and fourth claſs one brick, and if there be a cellar under the above paſſage, it muſt be arched over as above.

Backs of Chimnies in Party Walls, where they are not Back to Back.—Firſt Claſs.

The backs of all chimnies in the cellar ſtory muſt be one brick and a half thick, and all above the backs muſt be one brick thick; no perſon therefore can make any backs unleſs the walls are of an adequate thickneſs.

Chimnies

Chimnies Back to Back.——First Class.

When it ſo happens that chimnies fall back to back, there muſt be a two brick back in the cellar ſtory, and in each chimney on the ground floor one brick and half, and in every other chimney to the top there muſt be one brick backs.

Chimney Backs in the Second, Third, and Fourth Claſs.

Where the backs happen to fall as above in the cellar ſtories, there muſt be one brick and a half back, and all above one brick back throughout the houſe.

Of Chimney Flues in Party Walls.

The breaſt of every flue in the cellar ſtory ſhall be one brick, and between every funnel or flue there muſt be half a brick; and all funnels or flues muſt be pargetted within and without, except the outſide, which may be againſt ſome vacant ground; in ſuch caſe you muſt be ſure to white in ſome laſting manner the rim of every flue, funnel, or fire place.

Backs of Chimnies not in Party Walls.——First Claſs.

All chimney backs that are not in the party walls in this claſs muſt be in the cellar ſtory, one brick and a half in the back, and all above one brick.

Of

Of Second, Third, and Fourth Class ditto.

All the chimney backs in the circumſcription of the laſt mentioned claſſes of building muſt be one brick at leaſt from top to bottom.

Obſerve of chimney breaſts in general, that no diſcharging pieces are to be nearer than eighteen inches of the trimmers.

Note alſo, that all hearths in every room muſt be eighteen inches wide and one foot more in the opening of the chimney.

Of the Chimney Flues in Party Walls intended to be built.

Suppoſing any perſon ſhould be poſſeſſed of ground adjoining to any party wall about to be built, and is deſirous of having any rebates or receſſes left in the ſaid party wall (intended to be built) agreeably to act of parliament; or to have any chimney or chimnies, flues, &c. built and carried up with the ſaid party wall, ſuch perſon ſhall give notice in writing under his or her hand, particularly mentioning every ſuch chimney, &c. to the builder or builders, or any of them, before ſuch party wall ſhall be begun to be built; in which caſe, the wall muſt be conducted in a workmanlike manner, and according to the requeſt of the perſon giving ſuch notice, and ſuch perſons are liable to pay for the ſame as well as for a proportionable part of the wall.

No Timber near the Chimney.

Obſerve that no timber whatſoever is to be placed within two feet of any oven, ſtove, copper, ſtill, boiler, or furnace; nor muſt any bond timber be placed within nine inches of any opening of a chimney, or within five inches of any flue to any chimney.

Likewiſe be careful not to fix any chimney fronts or grounds of wood, nearer than five inches to the opening of the chimney, or inſide of the jambs.

All ſuch frames and door caſes muſt be fixed in reveals, and all ſtory poſts and breſſimers may be let into party walls not more than two inches; and all corner poſts muſt be of oak twelve inches ſquare at leaſt, or you muſt build ſtone piers.

Alſo obſerve that no chimney muſt be built upon timber, except what may be required for the foundations, piling, planking, &c.

Of Timbers on the outſide of Buildings.

All dormers, turrets, and other erections, placed on the outſide of buildings upon roofs, or flats, in the firſt, ſecond, third, fourth, or fifth claſs, muſt be covered with ſlate, tiles, tin, copper, or lead.

All outward decorations of balluſtrades, balconies, porticos, cornices, facios, windows, &c. and all other external projections of the

firſt,

first, second, third, and fourth class; and likewise every frontispiece to any building of the first class, either now or hereafter to be built, or any addition to such building, must externally be of brick, stone, stucco, lead, or iron, burnt clay, or artificial stone; except the cornices and dressings to shop windows; also every covered way or roof upon any portico, &c. is not to exceed the original line of the house, and such covered way must be covered with lead, stone, slate, tile, copper, or tin; nor must in height exceed (as well as any dressing to any shop window) above the till of the one pair of stairs window.

Nor must any rain water fall or drip into any publick streets, except from cornices, facios, porticos, &c. but must be conveyed by pipes and trunks into the channel stones of the drains; and wooden trunks to be used no higher than the bressimers.

No bow windows or other projections to be made in any square or publick street, save shop fronts, &c. beyond the line of the street.

Nor must any stall-board project in any street (thirty feet or more) a greater width than one foot six inches, nor in any street less than thirty feet wide more than thirteen inches, to be measured from the upright line of the building.

Of Old Plastered or Wooden Buildings.

All timber or plastered buildings may be repaired from time to time as usual; but if

at

at any time they ſhall be taken down as low as the breſſimer, then they muſt be built of brick or ſtone, with proper party walls, according to act of parliament.

Alſo remember that every building which was begun before the 24th of June 1775, and not being of the materials as directed by the late act, may be finiſhed, and afterward repaired as occaſion may require with the ſame ſort of materials as the originals, except the covering of roofs, dormers, and flats, which muſt be ſubjected to the former rules.

All buildings of the fifth and ſixth claſs not agreeable to the forementioned rules, and at proper diſtances, are liable to be pulled down, as publick nuiſances.

Any perſon preſuming to build, or alter an old building contrary to the general ſenſe and tenor of the act, and thereof convicted by the oaths of two or more witneſſes, before any two or more juſtices of the peace where ſuch buildings ſhall be ſituated, ſuch will be deemed a nuiſance, and the builder thereof muſt enter into a recognizance in ſuch ſum as the juſtices ſhall think fit, for either demoliſhing the ſame or amending it according to the forementioned rules, or on refuſal be ſent to a common gaol until the above terms be complied with.

The

The following is a Schedule of the Fees stipulated for Surveyors.

	£.	s.	d.
For every building of the 1st class	3	10	0
And to every alteration or addition to ditto ——	1	15	0
For every building or house of the second class ——	3	3	0
And every addition or alteration to ditto ——	1	10	0
For every building or house of the third class ——	2	10	0
Also every alteration to ditto	1	5	0
For every house or building of the fourth class ——	2	2	0
And every alteration or addition	1	1	0
For every house or building of the fifth class ——	1	10	0
Also for every addition or alteration to ditto ——	0	15	0
For every building or house of the sixth class ——	1	1	0
For every addition or alteration to ditto ——	0	10	6
For every building of the seventh class ——	0	10	6
And every alteration or addition to ditto ——	0	5	0

If

If any workman ſhould begin any buildings, or wall, or ſhould cut into any party wall without giving notice to the ſurveyor of the diſtrict, or otherwiſe refuſe to admit the ſurveyor to inſpect the ſame, ſuch perſon ſo offending ſhall forfeit double fees, and moreover forfeit the ſum of twenty pounds, and the building not being directly agreeable to the act, ſhall be demoliſhed or amended.

The ſurveyor, in ſuch caſe, is to give notice to the juſtice of the peace, and he ſhall order it to be amended or utterly demoliſhed.

Obſerve that every building is to be ſurveyed within fourteen days, and the ſurveyor muſt make oath that it is according to act of parliament.

Every journeyman whatever doing any thing contrary to the rules is liable to pay 50*l*. or ſuffer three months impriſonment.

The above directions are as ſhort and circumſtantial as the nature of the act would admit, and I ſincerely wiſh, that every workman as well as builder would make themſelves thoroughly perfect in the different claſſes of building, as well as the reſtrictions therein nominated, and not be too indolently negligent, through a view or perſuaſion that the aforementioned particulars will be repealed the preſent ſitting of parliament. As no perſon concerned in the building branch (being convicted) is exempt from puniſhment, ſo every man ought to be ſtudious for his own

 intereſt,

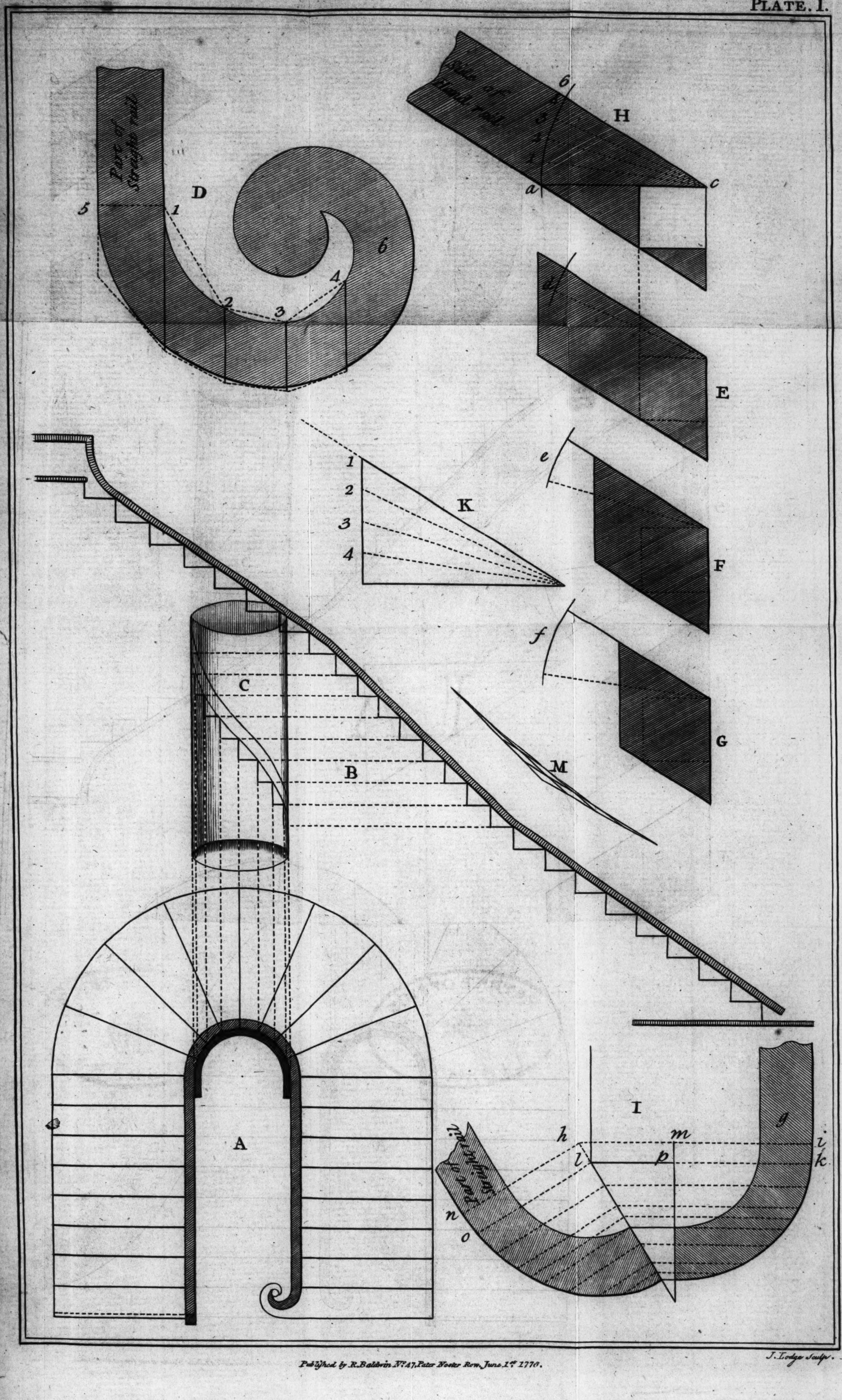
interest, as none can plead ignorance in an affair which is made publick to the world.

It is notwithstanding an affair greatly to be wished by all the working parties of the branches, not that the act should be repealed, but that the prices of surveyors should be taken off, it being there that the principal grievance lies, and which will, I am afraid (if not enquired into) be the destruction of many industrious families. It was certainly a great oversight in parliament not only to lay builders under grievances, but also to inforce a tax upon them; though it might not have been amiss with respect to new buildings, as a terror to those who knew not how to build at all: but it was surely a cruelty to tax the proprietors of buildings already erected, and which may want on every occasion some little repairing. The generality of mankind will think it very hard to make a little alteration in a building of the first class which may not amount to two or three pounds, and be obliged to give 1*l.* 15*s.* for the surveying of it; I say, this very exorbitant exaction will prevent hundreds of housekeepers and proprietors from doing numberless jobs, with a continuance. That is the chief support of two thirds of the working part of mankind in the building branch, there being numbers of jobbing masters who employ fifteen or twenty men the year round, that will shortly be reduced to one or two. If a tax had been with propriety

 levied,

levied, it should surely have fallen upon those benefited by it—the fire-offices—for it is certain if the present act be continued, a policy of insurance will not be of half the value it used to be; yet no other feasible method perhaps could be thought of, except government had been pleased to have taken the surveyors under their protection. However, if some other method of payment be not shortly devised and appointed, the builders will, I fear, be in a terrible situation, and hundreds of them reduced to practices which they have neither the will to perform, nor inclination to attempt.

F I N I S.



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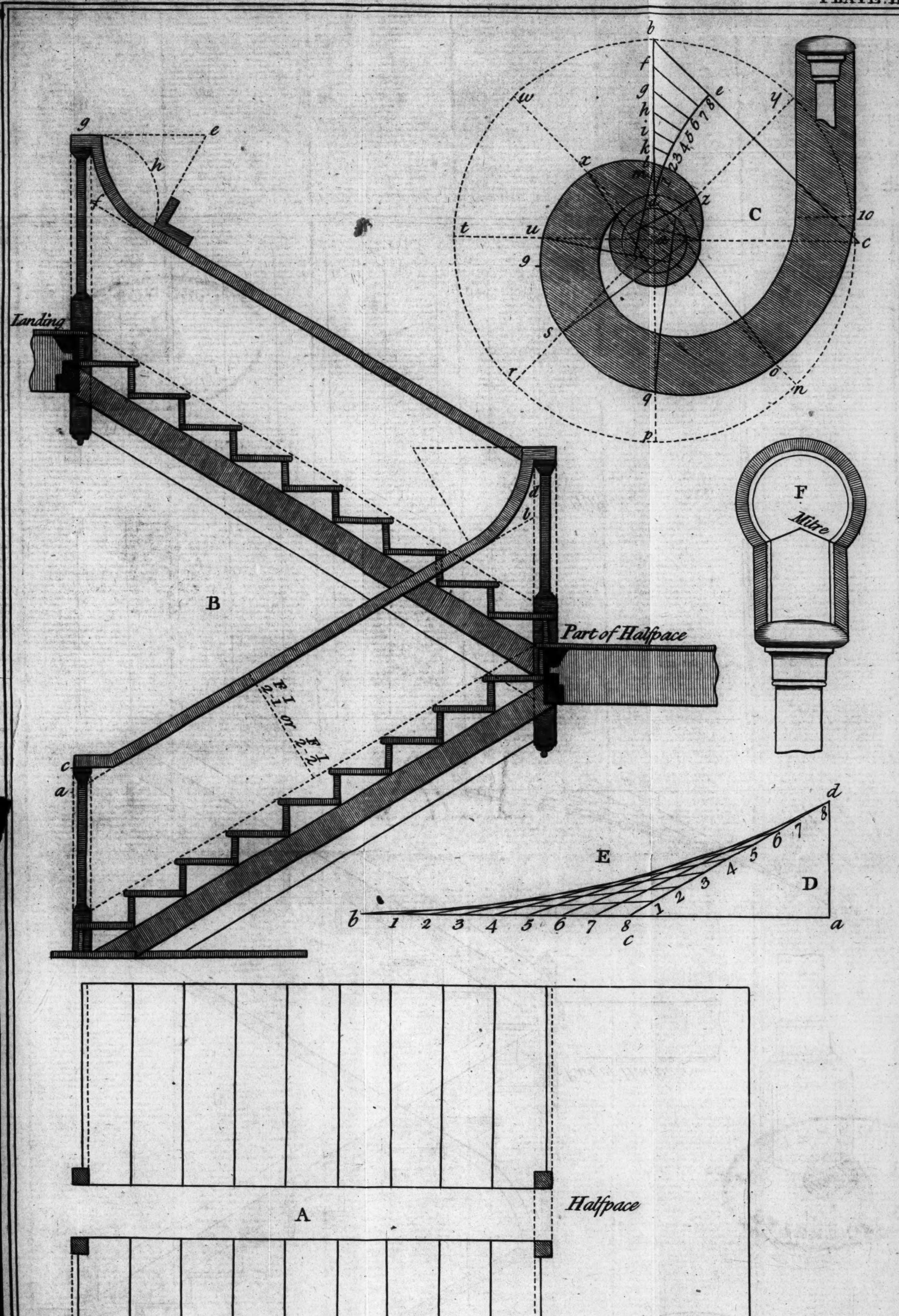

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